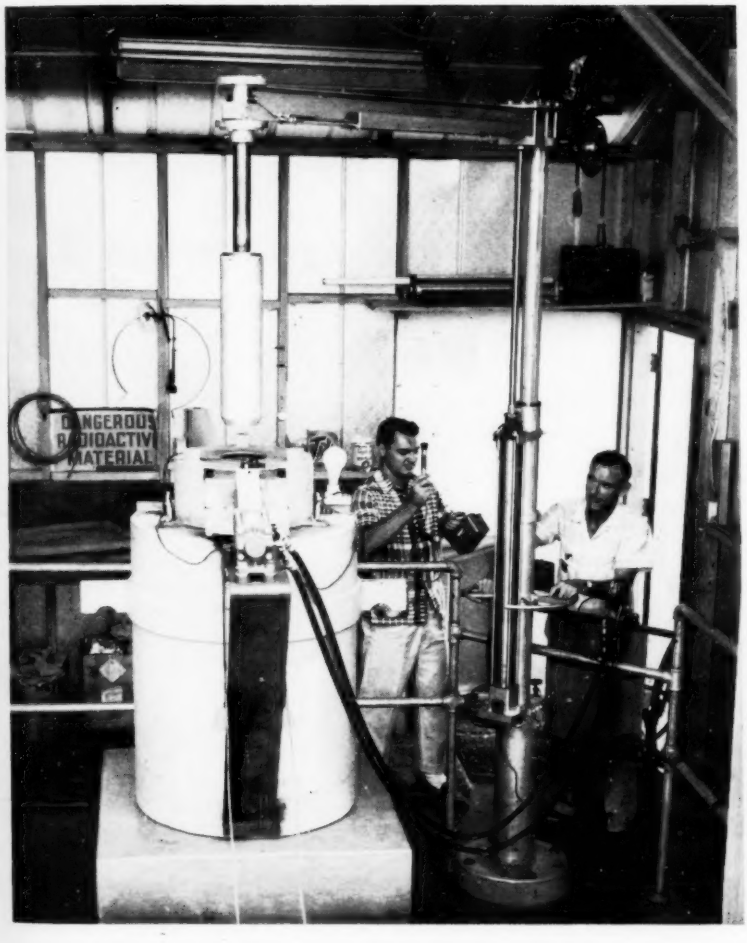
PEST CONTROL

JUNE
1961



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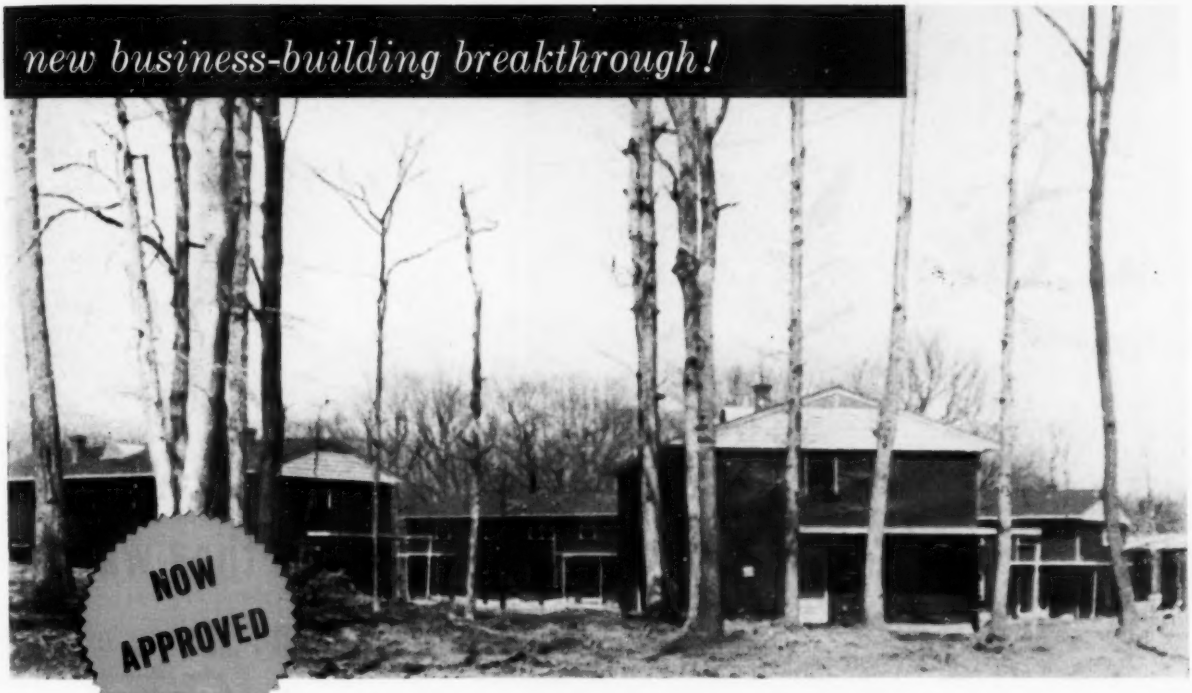

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PEST CONTROL

June, 1961

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Volume 29

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Bad Apples

It has been the editorial policy of *Pest Control* not to give further publication to occasional reports of itinerant racketeers who pass themselves off as legitimate pest control operators. There are relatively few of these instances and usually each involves a confined geographical area. Dramatizing such cases gives them importance they do not deserve and overshadows the efficient, honest service given by the majority of PCOs in this country. Such frauds are best handled locally by industry members, Better Business Bureaus, and law enforcement agencies.

We have been criticized however for calling attention to practices in our industry where there is room for improvement. We have been accused of "small talk" when *Pest Control* singles out segments of the pest control field where pricing practices, for example, should be improved.

Whatever the reasons behind cut-rate, unrealistic pricing, this method of getting business is a major concern in this industry, one greater even than resistance. And maybe roaches could be controlled more effectively if PCOs could get the price they need to spend the necessary time to do the job thoroughly on every call. Pricing is not a problem only of this business. Chemical houses, equipment manufacturers, etc., etc., all are confronted with price chiselers. But what happens in the pest control industry *is* our problem. That's why we're dedicated to do something about it.

There is a difference between our editorial positions on these two points. In one we refuse to broadcast the activities of illegal opportunists who jump from one industry to another and are not representative or typical of any. On the other hand every leader in the pest control industry has a responsibility to educate the unknowing, or newcomers in our field so consumers won't confuse inexperienced firms with died-in-the-wool bad apples.

Letters

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Getz Exterminators, Inc.
Atlanta, Ga.

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Development Department
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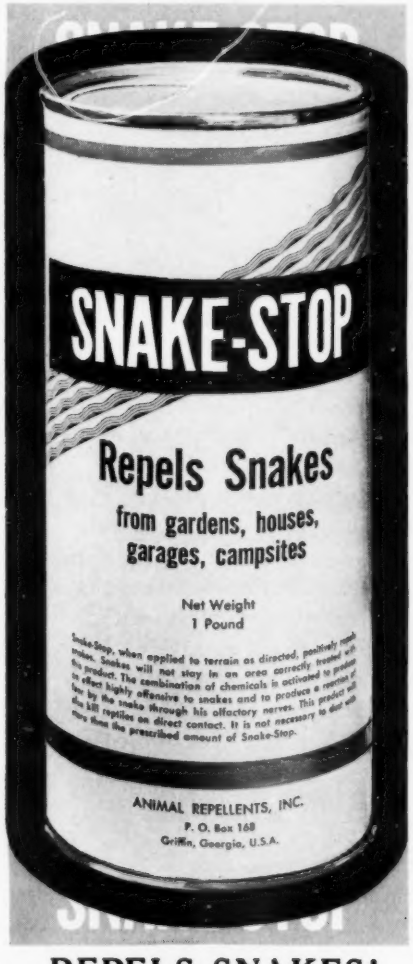

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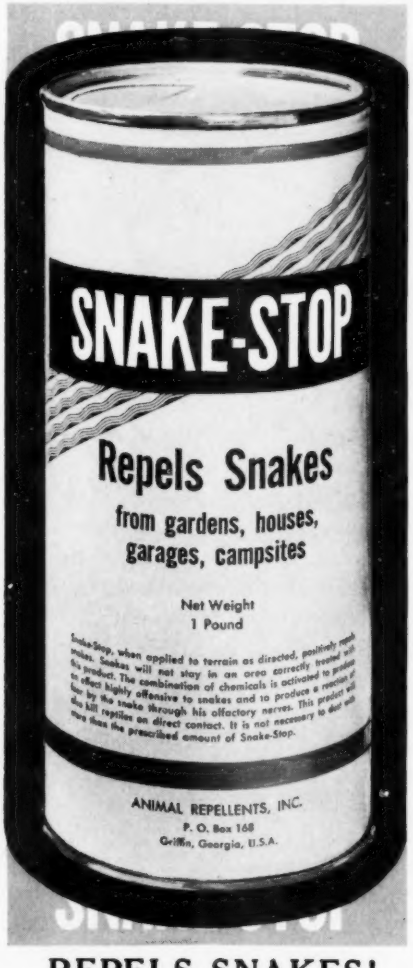

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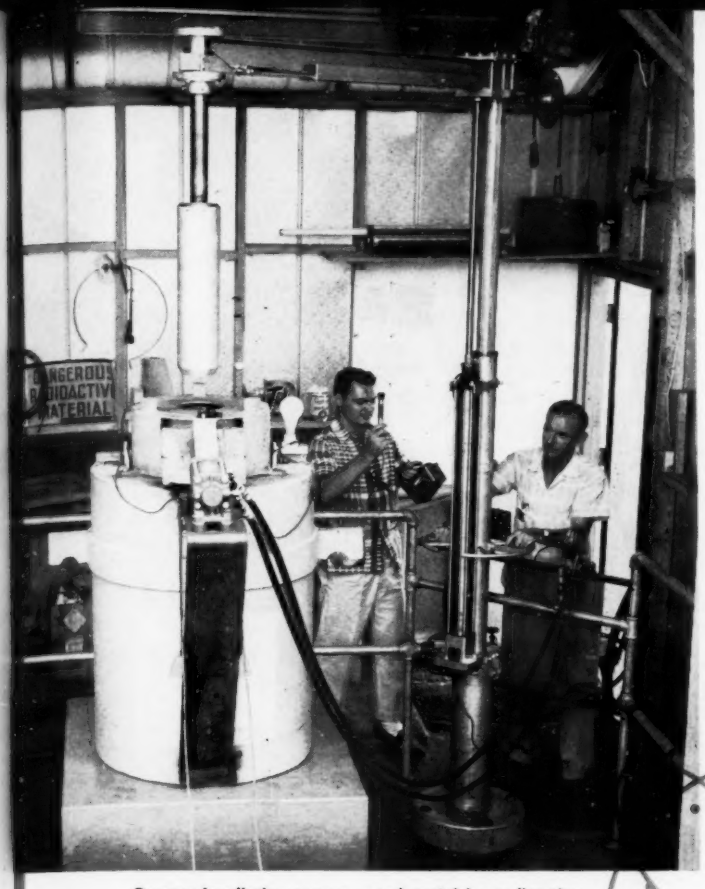

Gamma irradiation source — cask containing radioactive cobalt. Screw-worms or other insects are placed into small cylinder and lowered into cask for irradiation and consequent sexual sterilization.

NEW WAYS TO CONTROL INSECTS

by

DR. ARTHUR W. LINDQUIST

Chief

Insects Affecting Man and Animals Research Branch

United States Department of Agriculture

Beltsville, Maryland

THE PROBLEM of resistance to insecticides has stimulated serious efforts to develop new ways of controlling insects. In addition, the rigid requirements with respect to residues in meat, milk, and plant products as well as the possible deleterious effect of chemicals on wildlife and on beneficial insects have challenged researchers. Thus it is not surprising that for several years farsighted entomologists have given profound thought to new approaches to these problems.

Pest control operators, confronted with resistance to and the need for safety and effectiveness of insecticides, are much interested in keeping up with trends in research and control. It is the purpose of this report to review recent work, present thinking, and future plans regarding new ways to combat noxious insects.

The basic fact that sterile males mated with normal females cannot beget their own kind has been known for many years. In the 1920's geneticists working with *Drosophila* discovered that X rays render these insects incapable of reproducing. This discovery received little attention by entomologists until 1938, when E. F. Knipling considered the practical use of sterility to control the screw-worm (*Callitroga hominivorax* (Coquerel)). Entomologists now recognize that sterility in insects can be caused by gamma irradiation, chemicals, hybridization, and perhaps other ways.

Sterility by Gamma Irradiation

Gamma rays penetrate living cells and are damaging to rapidly developing tissues. The susceptibility of rapidly dividing germ cells allows treatment of an insect with a minimum of damage to the slower developing somatic (non-reproductive) tissues. Cells in the reproductive organs usually begin rapid division in the pupal stage after somatic tissues have nearly reached complete development. Timing and dosage of irradiation are therefore important with each species. The use of irradiation to cause sterility on several insects has been studied and is discussed briefly below.

Screw-worm

Much has been written about the spectacular eradication of the screw-worm in the Southeast by means of the sterile-male technique. The highly successful eradication of this insect from a large area ranks as one of the most outstanding entomological accomplishments of all time. The concept of using males that are normal in every way, except they have been made sexually sterile, is exciting. If the released sterile males are vigorous and competitive, the logical expectation is that they will seek out the normal females and render them reproductively ineffective. Thus control would be much more thorough and last longer than that achieved by spraying or by using any other known method.

The gamma-induced sterility method consists essentially of rearing and sterilizing insects, and releasing males into a natural population. These males mate with na-

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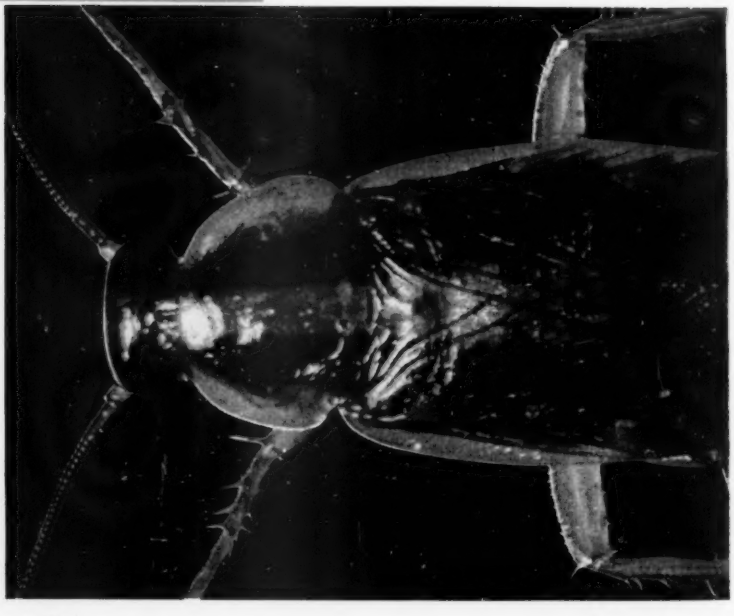

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tive females and destroy their ability to reproduce. For introduction into infested areas, sterile males must be systematically released in numbers greater than exist in nature. Their very preponderance gives them a great advantage in competing for native females.

The successful screw-worm eradication project in the Southeast was the result of a research program that included a few small-scale field trials conducted over a period of several years. Eradication in the Southeast was thought to have a good chance of success because the screw-worm overwintered in Florida, a peninsular area, and the only source of reinfestation was from the Southwest. To prevent reinfestation from the Southwest a quarantine line was set up for the purpose of inspecting and treating infested cattle along the Mississippi River. In August 1958, the U. S. Department of Agriculture joined with the State of Florida to provide funds. The USDA Animal Disease Eradication Division was charged with administrative responsibility for the project, and the Florida Livestock Board carried out the State's obligations. Because of the complexity of the program, several entomologists from the Entomology Research Division were asked to assist with its technical direction.

An enormous rearing facility was completed at Sebring, Florida. Production was aimed at rearing 50 million screw-worm flies (half of them males) for release each week. The flies, in specially-designed cardboard containers, were released systematically by aircraft over the entire State of Florida and parts of Georgia and Alabama. After a period of about 17 months, no screw-worm infestations or fertile adult flies of the species could be found in these three States. Release of sterile males was halted on November 14, 1959, and no local infestations have been noted since that time. Therefore, we may conclude that the species has indeed been eradicated.

The research that made this eradication possible did not appear suddenly as a complete, ready-to-apply technique, as might be supposed from reading popular articles on the subject. Since 1915 or so, many persons had studied the biology and ecology of the screw-worm. In 1938 available research information (Lindquist, unpublished report) indicated that in parts of Texas the number of flies per square mile was only a few hundred rather than the thousands that had been supposed. The low per-square-mile insect count suggested the practicability, at least in selected areas, of releasing a greater proportion of sterilized males than that of males existing in the natural population. Other biological and ecological information supported the theory that sterile males could be used to control or eradicate the screw-worm flies.

Author Lindquist says much of the information in this article is being published for the first time.

Actual sterilization experiments were begun in about 1950. Bushland and Hopkins (1951, 1953) found the optimum time for sterilizing the screw-worm to be 5 to 6 days after pupation at 80°F., or 2 to 3 days before adult emergence. A dose of 2500 r caused sterility of males and 5000 r of females without interfering with their normal behavior. An important early finding was that a mixture of ground lean beef, blood, and a small amount of formaldehyde provided a satisfactory medium for rearing the flies at approximately 100°F. (Melvin and Bushland 1940). Graham and Dudley (1959) modified the content by substituting other lean meats for beef so that the medium would be practical for use in large-scale operations.

The discovery was also made that the screw-worm females mate only once, a fact that seemed to favor use of the method. However, it should be pointed out that single matings are not a prerequisite to the successful use of the sterile-male method, at least in laboratory experiments. Theoretically, multiple-mating species may be used, since a population containing up to 10 times as many sterile as normal males gives the advantage to the sterile males even if the females mate more than once.

Fruit Flies and Other Insects

The application of the sterile-male technique to other insects was slow in getting started. This delay was probably because of insufficient funds and a lack of understanding of all the principles involved. However, intensive research on the possible use of the method against the Mediterranean fruit fly (*Ceratitis capitata* (Wied.)), melon fly (*Dacus cucurbitae* Coquillett), and the oriental fruit fly (*Dacus dorsalis* Hendel) has led to initiation of field tests. The USDA Hawaii Fruit Fly Laboratory, in cooperation with the U. S. Navy and the Trust Territories, is conducting a test on an island near Guam. These fruit flies are easily reared and have other characteristics lending strength to the opinion that this test will be successful.

Laboratory and small-cage tests have shown that the common malaria mosquito (*Anopheles quadrimaculatus* Say) responds to irradiation and mates in a manner similar to that of the screw-worm. The laboratory work with this insect was so promising that in 1960 a small field test was initiated on a 5-square-mile peninsula in Lake Okeechobee, in Florida. Releases were made at a rate of about 1500-2000 males per square mile per week, which should have exceeded by several times the normal population. However, after releasing sterile males for a year, we concluded that the test had failed since the natural population of mosquitoes did not decline.

The paucity of information on the habits of the common malaria mosquito under field conditions has hampered work on the release experiment. An understanding of the normal situation in the field is of great importance and often

is absolutely vital to the design of tests and to the determination of whether the method is practical. For example, how far do released male mosquitoes migrate in search of females and how effective are they in mating behavior? What time of day does mating usually occur and under what conditions? Answers to these questions could be critical. Does mating occur near emergence sites or at other locations that could only be determined by long-time ecological studies? The answer to this question could have a bearing on where release of sterile males would be most effective.

Preliminary research on the effects of gamma radiation and the possible use of the sterile-male method has been conducted on several other insects, such as the boll weevil (*Anthonomus grandis* Boheman), the codling moth (*Carpocapsa pomonella* (L.)), The European corn borer (*Pyrausta nubilaiis* (Hubner)), and tsetse flies (*Glossina* spp.), but none of the work has advanced to a field-test stage. In theory, good reasons exist for the belief that the sterile-male method might be practical with at least some of these insects. However, economical control by this method may not be possible until the natural population is first reduced by other means. Authorities on these major pests recognize that much research will be required. Methods of rearing the insects and of producing sterility must be worked out, and the biology and ecology of the insects involved must be understood before the value of this approach can be adequately determined.

The possibilities of using gamma-induced sterility of male insects for the control of such household pests as cockroaches does not appear practical or very promising at this time. The method of control involves release of more insects than exist in the natural environment. Would householders or the owners of business establishments tolerate increased numbers of cockroaches, flies, and other pests? Even if the release period involved only a few months with hope of ultimate success, we doubt that the method would meet with much favor. Furthermore, even though rearing, irradiation, and performance of sterile males were favorable, the constant threat of reinfestation would be a problem. For example, cockroaches and house flies are easily transported in many commercial products. Preventing them from reentering areas free of the pests would be almost impossible.

Sterility by Means of Chemicals

The use of chemicals to cause sexual sterility in insects without adversely affecting sexual vigor or behavior has exciting possibilities. Chemosterilants would provide an easier and less costly way than irradiation for sterilizing reared insects used in large-scale control projects. However, the principal advantage of using chemical sterilants would be that release of sterile insects into the natural population would not be required. The chemical could be incorporated into a bait or lure so that the insects would be drawn to a central point to feed. Or chemosterilants, applied in the same way as insecticides, might sterilize the insect

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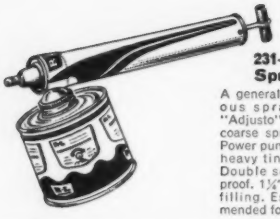

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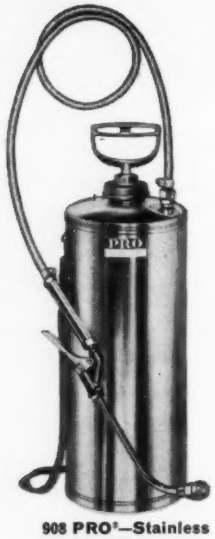

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coming in contact with their residues.

If a high percentage of the natural population were rendered sterile by such a procedure, the females that were sterile would be incapable of producing progeny. Of equal or greater significance, the sterile males would compete with the fertile males in mating with the remaining normal untreated females. Thus the biotic potential of the entire population would be further reduced. As Knipling (1959) pointed out, the population decline should be much more rapid when sterile males are continually present than when chemicals are employed to kill the insects.

This attractive scheme presupposes that we can develop safe chemicals that will be as effective for sterilizing insects as those we now use for killing them. However, a powerful lure or attractant specific for certain insects might permit the use of such materials with safety, even though they may be too hazardous for treating the environment where the insects occur. Scientists in an all-out research program could probably produce a good lure for many insect species. Thus full advantage of the chemical-sterility principle of insect control could be taken.

Recent Research at Orlando, Florida

Finding a safe and effective material that would produce sterility when insects rest on a residual deposit or when they ingest such a compound is not as visionary as might be supposed. For many years we have known that certain chemicals cause sexual sterility in insects, or at least prevent ovarian development.

About 2 years ago our Orlando, Fla., laboratory initiated a program to find compounds having sterilizing or growth-inhibiting effects on the house fly (*Musca domestica* L.) and other insects. The Division's fruit fly laboratories in Mexico City and Hawaii are also engaged in similar screening programs. We feel that ample justification exists for exploring the possibilities of chemicals that can be used against insects in other ways than to kill directly.

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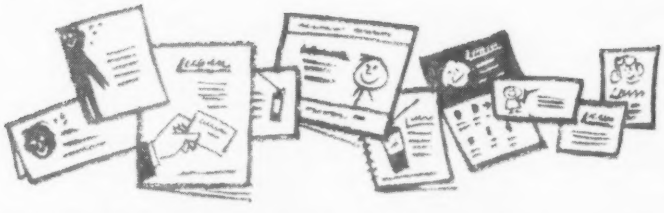

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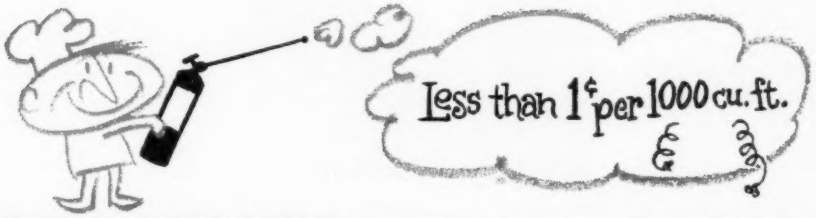

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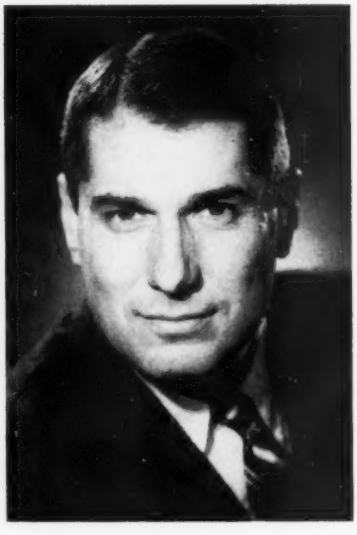

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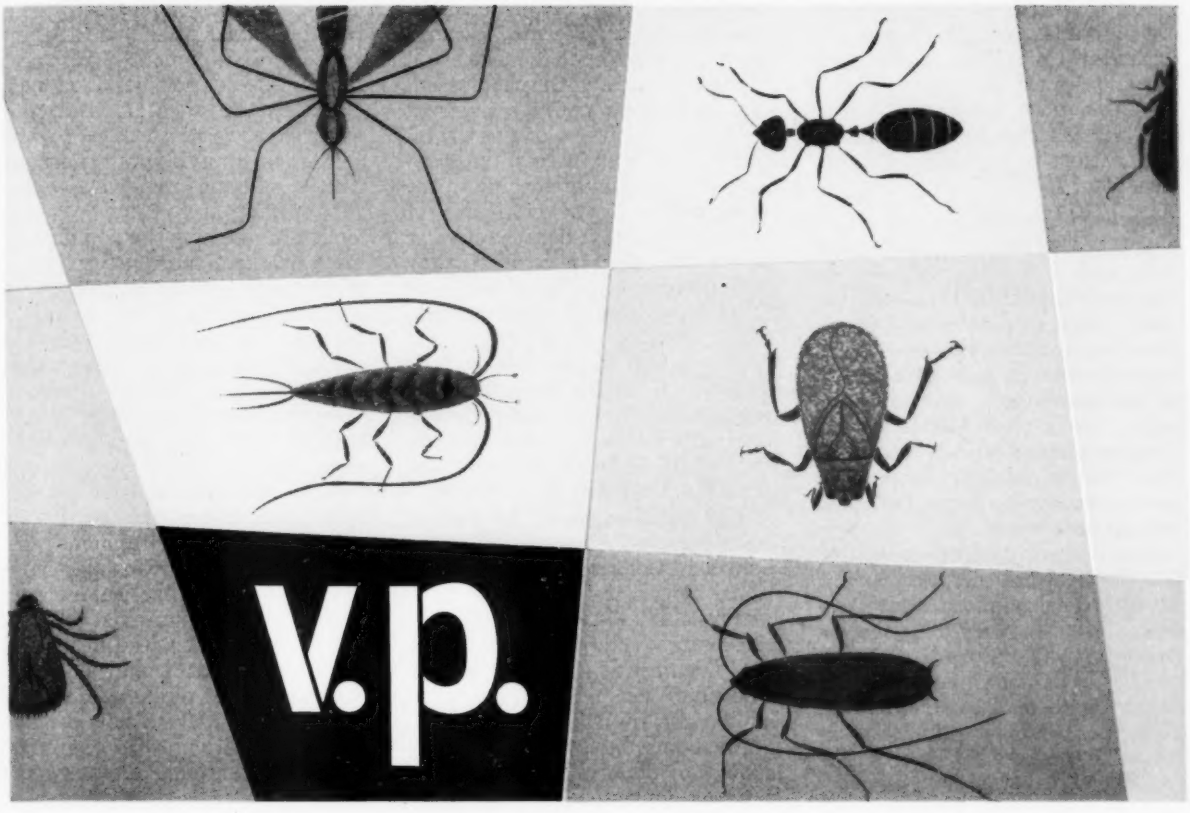
evaluated at Orlando. Some induce biological effects that are of interest. Amethopterin (LaBrecque *et al.* 1960) was found to prevent female house flies from ovipositing but had no effect on the males. At a concentration of 0.5% in a sugar bait, a single feeding of this compound prevented oviposition. Oviposition by flies given a choice of treated and untreated food was only 2% of that by flies given untreated food. However, the potential effectiveness of this chemical in the field is not as great as it would be if the males were also made sterile by its action. But perhaps the males could be rendered sterile by another chemical that would at the same time allow them to compete sexually with untreated males. Or, better still, a compound could be developed that would render both sexes sterile.

Recently 3 compounds have been found at our Orlando laboratory that have considerable promise as sterilizing agents against house flies, mosquitoes, and other insects. They are especially interesting since they sterilize the males as well as the females.

These compounds reported by G. C. LaBrecque at the 1960 Atlantic City meetings of the Entomological Society of America are tris(1-aziridinyl)phosphine oxide, *N, N'*-ethylenebis[*P, P*-bis(1-aziridinyl)-*N*-methylphosphinic amide], and hexakis(1-aziridinyl)-phosphonitrilate.

These compounds cause sterility of both sexes at concentrations of 1 to 0.5% in food given to adult insects. Females given treated food and mated with normal males produced only a few eggs and these did not hatch. Matings of treated males with normal females resulted in almost normal egg production but none of the eggs hatched. The flies must feed on treated food within 3 days after emergence in order to become sterile. In small cage tests treated flies competed satisfactorily with normal flies. In room tests in large cages, flies given untreated food produced 40,088 pupae, whereas flies given a choice of treated and untreated food produced 13 to 121 pupae. These results are dramatic and suggest that chemosterilants have a reasonable chance of providing practical control. Of great signifi-



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cance is the recent finding by our Orlando and Kerrville, Texas, laboratories that these compounds actually cause sterility in stable flies (*Stomoxys calcitrans* (L.)) as well as house flies following topical applications or exposure to a residual film.

Projecting Laboratory Results to the Field

In such a new area of research, the projection of favorable laboratory results to successful field applications may require special and unusual research techniques as well as new methods of evaluating results. The Orlando laboratory has field tests under way against house flies. No doubt many interesting facts regarding chemosterilants will be uncovered.

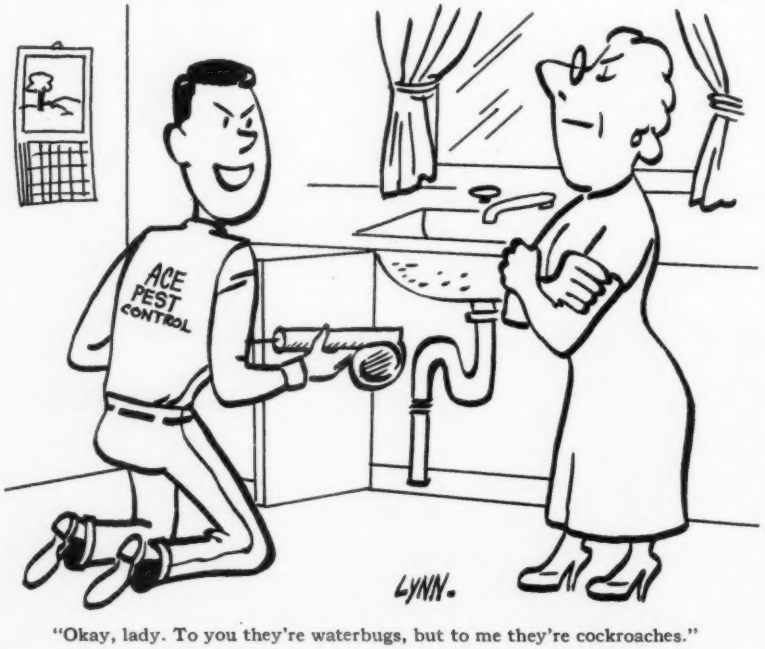
One immediate problem will be the slow control of flies. In fact, we can theorize that at least a few weeks will be required to show a depression in a natural population even if it is reasonably isolated from sources of reinfestation. Therefore, chemosterilants probably will not be satisfactory for controlling insects after they have become serious pests. Instead these chemicals probably will be most practical in preventing population buildups on a community or regional basis. Thus the effect of migrating specimens could be minimized.

In order to take full advantage of chemosterilants, much research must be conducted to determine where, when, and how to apply these materials. However, they offer unusual possibilities. Perhaps insecticides and chemosterilants could be used jointly. The insecticide would rapidly depress high populations, and the chemosterilant would delay buildup. With the house fly, for example, the sterilant might be applied in the immediate vicinity of neglected breeding areas to reduce the overall biotic potential, whereas the insecticide would provide control immediately essential in barns, homes, or other places.

A combination of a conventional type of insecticide and a chemosterilant could even be the solution to the insecticide-resistance problem. At first thought we might ask: Why kill flies that are sterile and thereby nullify the possible advantage of a sterility producing compound? But, let us consider this possibility: We may assume, with reasonable confidence, that the insecticide and the chemosterilant will have entirely different modes of action. As long as the insecticide kills all insects, the sterilant will contribute nothing to the combination. However, if any of the insects survive because of vigor or physiological resistance, they will become sexually sterile and thus incapable of reproducing. Their sterility will automatically halt selection for resistance. It is apparent from this discussion that we do not know how useful chemosterilants will be for insect control, but we do feel that this new approach offers many possibilities.

The effective use of chemosterilants against mosquitoes under field conditions is entirely suppositional at this time although laboratory studies have shown that these compounds perform satisfactorily against at least one species. The emergence, mating, and other habits of various species of mosquitoes must be fully known. The control of malaria mosquitoes by residual applications in buildings with these materials does not look promising. The females have usually mated before entering the buildings and few males are present. However, because insecticide resistance is a serious problem in malaria eradication, the utilization of a sterilant plus a conventional residual insecticide to prevent the development of resistant strains should not be ruled out. Treating the vegetation around emergence areas to sterilize the adults or applying the sterilant with or without insecticides to larval breeding areas may prove effective in reducing the population. Each species of mosquito will have to be considered in relation to its particular habits.

Insecticides usually control about 90% of cockroaches in buildings. Complete control does not occur because some of the insects have unusual vigor, acquire resistance, fail to contact the insecticide, or are introduced from another area. Since roaches live in a fairly closed environment, the chemosterilant approach may have some promise for practical use, but certain drawbacks exist. Under natural conditions, the action of a chemosterilant would be very slow because of the long life cycle of these insects. Such slow control would probably not be acceptable in most situations. However, it seems possible that a combined insecticide-chemosterilant treatment applied in buildings would remain effective longer than the insecticides alone, especially when resistance has developed, or is developing. The insecticide would quickly reduce the population and



"Okay, lady. To you they're waterbugs, but to me they're cockroaches."

the chemosterilant would, in theory, render vigorous survivors and introduced specimens incapable of reproducing. The reader should realize that the preceding ideas are purely theoretical and must be carefully evaluated both in the laboratory and in the field.

What is known about the safety of these compounds? Those mentioned above are known as alkylating agents and one of them is used commercially in the treatment of cotton fabrics for crease resistance and other purposes. It has also been used experimentally in the treatment of cancer. This group of compounds must be considered hazardous to warm-blooded animals. However, there are no indications that they are carcinogenic. Much research would be necessary to determine if such materials can be used safely. Continued investigations will undoubtedly uncover compounds that have a minimum toxicity and hazard. Furthermore, these compounds must not sterilize warm-blooded animals or, as an alternative, methods of employing them must be developed so that animals or man will not be exposed to the chemicals. Another problem will be to find compounds that do not create excessive hazards to beneficial microorganisms in the soil or water and that do not adversely affect beneficial parasites and predators.

Sterility by Hybridization

Sterility in insects can be caused by crossing certain closely related species, races, or strains. It might be possible to introduce males of a laboratory strain or species that would mate with wild females and cause sterility. Vanderplank (1946) suggested that one of the tsetse flies, *Glossina swynnertoni* Austin, could be eliminated — at least if it had first been reduced to a low level by other means — by the massive introductions of *G. morsitans* Westwood. This suggestion was based on the fact that a crossing of these two species produce very few offspring, most of which are sterile.

Downes (1959) elaborated on the above concept of hybridization and reviewed the possibility of controlling the gypsy moth (*Porthetria dispar* (L.)) in America by the rearing and release of a "strong" race of this species, that is, one having potent sex-determining factors.

The North American gypsy moth is classified as a "half-weak" race, whereas strong races are found in Eastern Asia. The proposal was to rear one of the strong races in large numbers and liberate the males only. The females with which these males mated would produce a generation of offspring in which the females would be intersexual (having intermediate characters of male and female, and being sterile). The males would be fertile and able to breed with surviving native females, but about half of the female progeny would again be intersexual. This situation would come about because, in the gypsy moth as well as in other Lepidoptera, the female is the heterogametic sex, that is, the gametes are unlike, not similar. Within this Order of insects, the male determining factors lie in the X chromosome. The single X

(*Continued on page 36*)

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cance is the recent finding by our Orlando and Kerrville, Texas, laboratories that these compounds actually cause sterility in stable flies (*Stomoxys calcitrans* (L.)) as well as house flies following topical applications or exposure to a residual film.

Projecting Laboratory Results to the Field

In such a new area of research, the projection of favorable laboratory results to successful field applications may require special and unusual research techniques as well as new methods of evaluating results. The Orlando laboratory has field tests under way against house flies. No doubt many interesting facts regarding chemosterilants will be uncovered.

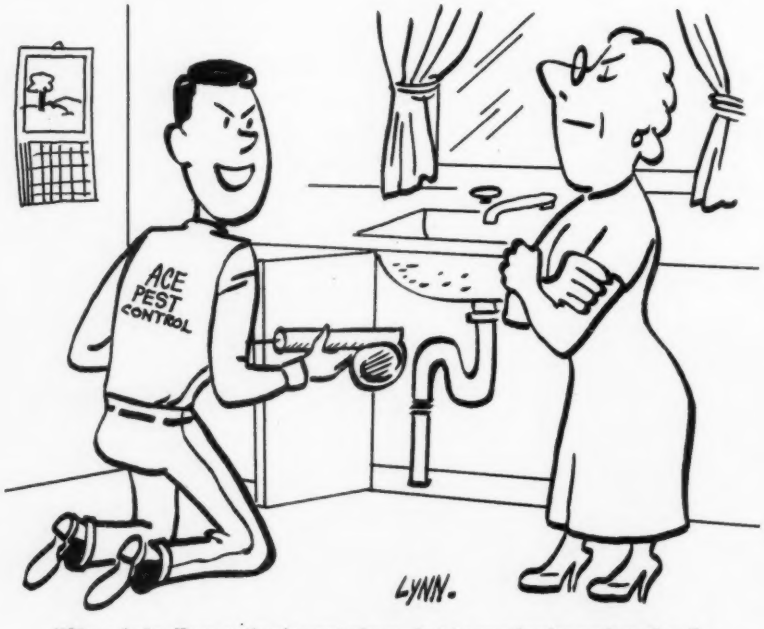
One immediate problem will be the slow control of flies. In fact, we can theorize that at least a few weeks will be required to show a depression in a natural population even if it is reasonably isolated from sources of reinfestation. Therefore, chemosterilants probably will not be satisfactory for controlling insects after they have become serious pests. Instead these chemicals probably will be most practical in preventing population buildups on a community or regional basis. Thus the effect of migrating specimens could be minimized.

In order to take full advantage of chemosterilants, much research must be conducted to determine where, when, and how to apply these materials. However, they offer unusual possibilities. Perhaps insecticides and chemosterilants could be used jointly. The insecticide would rapidly depress high populations, and the chemosterilant would delay buildup. With the house fly, for example, the sterilant might be applied in the immediate vicinity of neglected breeding areas to reduce the overall biotic potential, whereas the insecticide would provide control immediately essential in barns, homes, or other places.

A combination of a conventional type of insecticide and a chemosterilant could even be the solution to the insecticide-resistance problem. At first thought we might ask: Why kill flies that are sterile and thereby nullify the possible advantage of a sterility producing compound? But, let us consider this possibility: We may assume, with reasonable confidence, that the insecticide and the chemosterilant will have entirely different modes of action. As long as the insecticide kills all insects, the sterilant will contribute nothing to the combination. However, if any of the insects survive because of vigor or physiological resistance, they will become sexually sterile and thus incapable of reproducing. Their sterility will automatically halt selection for resistance. It is apparent from this discussion that we do not know how useful chemosterilants will be for insect control, but we do feel that this new approach offers many possibilities.

The effective use of chemosterilants against mosquitoes under field conditions is entirely suppositional at this time although laboratory studies have shown that these compounds perform satisfactorily against at least one species. The emergence, mating, and other habits of various species of mosquitoes must be fully known. The control of malaria mosquitoes by residual applications in buildings with these materials does not look promising. The females have usually mated before entering the buildings and few males are present. However, because insecticide resistance is a serious problem in malaria eradication, the utilization of a sterilant plus a conventional residual insecticide to prevent the development of resistant strains should not be ruled out. Treating the vegetation around emergence areas to sterilize the adults or applying the sterilant with or without insecticides to larval breeding areas may prove effective in reducing the population. Each species of mosquito will have to be considered in relation to its particular habits.

Insecticides usually control about 90% of cockroaches in buildings. Complete control does not occur because some of the insects have unusual vigor, acquire resistance, fail to contact the insecticide, or are introduced from another area. Since roaches live in a fairly closed environment, the chemosterilant approach may have some promise for practical use, but certain drawbacks exist. Under natural conditions, the action of a chemosterilant would be very slow because of the long life cycle of these insects. Such slow control would probably not be acceptable in most situations. However, it seems possible that a combined insecticide-chemosterilant treatment applied in buildings would remain effective longer than the insecticides alone, especially when resistance has developed, or is developing. The insecticide would quickly reduce the population and



"Okay, lady. To you they're waterbugs, but to me they're cockroaches."

the chemosterilant would, in theory, render vigorous survivors and introduced specimens incapable of reproducing. The reader should realize that the preceding ideas are purely theoretical and must be carefully evaluated both in the laboratory and in the field.

What is known about the safety of these compounds? Those mentioned above are known as alkylating agents and one of them is used commercially in the treatment of cotton fabrics for crease resistance and other purposes. It has also been used experimentally in the treatment of cancer. This group of compounds must be considered hazardous to warm-blooded animals. However, there are no indications that they are carcinogenic. Much research would be necessary to determine if such materials can be used safely. Continued investigations will undoubtedly uncover compounds that have a minimum toxicity and hazard. Furthermore, these compounds must not sterilize warm-blooded animals or, as an alternative, methods of employing them must be developed so that animals or man will not be exposed to the chemicals. Another problem will be to find compounds that do not create excessive hazards to beneficial microorganisms in the soil or water and that do not adversely affect beneficial parasites and predators.

Sterility by Hybridization

Sterility in insects can be caused by crossing certain closely related species, races, or strains. It might be possible to introduce males of a laboratory strain or species that would mate with wild females and cause sterility. Vanderplank (1946) suggested that one of the tsetse flies, *Glossina swynnertoni* Austin, could be eliminated — at least if it had first been reduced to a low level by other means — by the massive introductions of *G. morsitans* Westwood. This suggestion was based on the fact that a crossing of these two species produce very few offspring, most of which are sterile.

Downes (1959) elaborated on the above concept of hybridization and reviewed the possibility of controlling the gypsy moth (*Porthetria dispar* (L.)) in America by the rearing and release of a "strong" race of this species, that is, one having potent sex-determining factors.

The North American gypsy moth is classified as a "half-weak" race, whereas strong races are found in Eastern Asia. The proposal was to rear one of the strong races in large numbers and liberate the males only. The females with which these males mated would produce a generation of offspring in which the females would be intersexual (having intermediate characters of male and female, and being sterile). The males would be fertile and able to breed with surviving native females, but about half of the female progeny would again be intersexual. This situation would come about because, in the gypsy moth as well as in other Lepidoptera, the female is the heterogametic sex, that is, the gametes are unlike, not similar. Within this Order of insects, the male determining factors lie in the X chromosome. The single X

(*Continued on page 36*)

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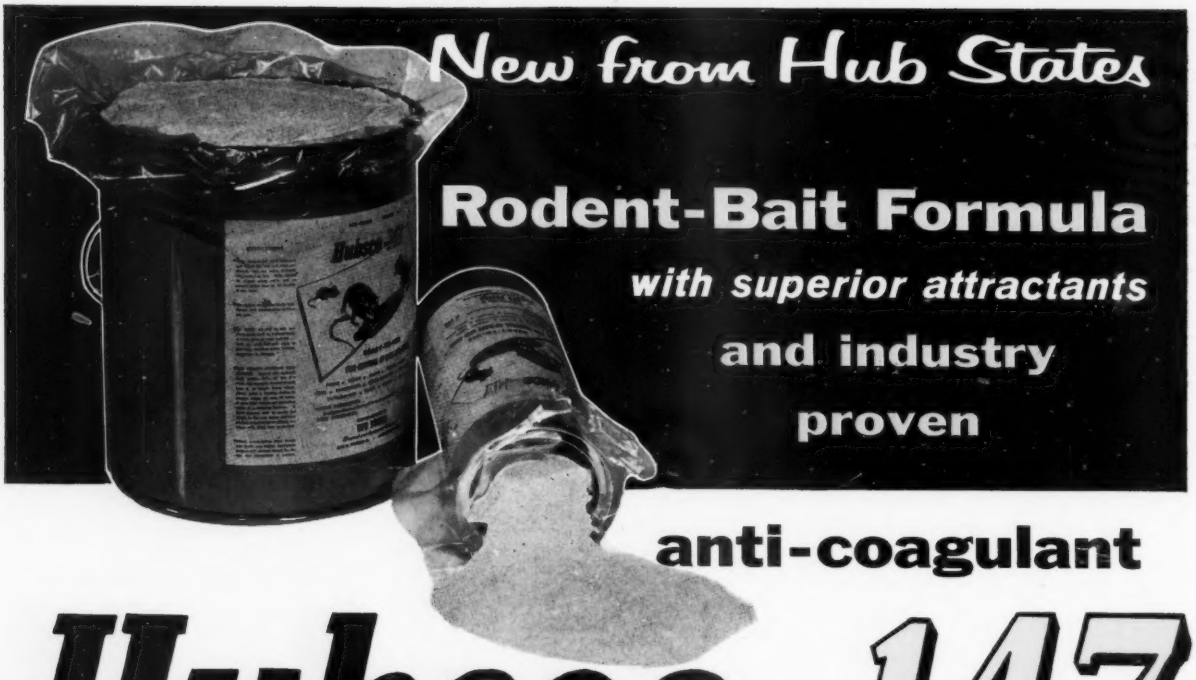

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Correspondence Course in Pest Control Technology

By DR. LEE C. TRUMAN*

Lesson No. 6

Cockroaches

(Order Orthoptera, Family Blattidae)

COCKROACHES are among the most common insects. During the Carboniferous Period, some 200,000,000 years ago, they were present in tremendous numbers and some of them were several inches long. Roaches have been among the most adaptable of insects and have been able to survive many changing environments as is indicated by the fact that approximately 3500 species exist in the world today with 55 species known to live in the United States.

Most cockroaches are tropical or sub-tropical in origin generally living out of doors and being most active at night. They ordinarily prefer a moist environment with a relatively high degree of warmth. Some tropical roaches feed only on vegetation; however, roaches which live in houses are usually scavengers exhibiting a wide choice of food. These insects are especially fond of starchy materials, sweet substances, and meat products, but will also eat a great variety of materials such as cheese, beer, leather, bakery products, starch in book bindings, glue, hair, dead animals, and plant materials.

Roaches produce odorous secretions which may affect the flavor of food and which, when the population is high, imparts an odor to the air in the general region of the infestation. These insects have the ability to carry disease producing organisms, but in general, cockroaches are not particularly associated with illness or disease outbreaks. Although several digestive diseases have been transmitted experimentally, gastroenteritis appears to be the principal one for which roaches can be considered a natural vector.

Only a few of the cockroach species which live in the United States inhabit man's dwellings. The most common of these are the American cockroach, German cockroach, oriental cockroach, brown-banded cockroach, smoky brown cockroach, Australian cockroach, brown cockroach, woods cockroaches, field cockroach, and the lobster cockroach.

The first 8 of these are the most common and can be separated from each other by use of the pictorial key in Figure 6-B. This key provides a choice at any point between two characteristics and can be used in the same manner as the key to orders of insects in Lesson Two.

LIFE CYCLES AND BEHAVIOR

Since cockroaches develop by gradual metamorphosis, their life cycle consists of three stages: egg, nymph, and adult. The female produces a purse-shaped case, called the ootheca, which has two rows of eggs in it. The egg cases of some common species can be identified by reference to the pictorial key in Figure 6-A. Nymphs hatch out of the eggs and break

Figure 6-A

A Key to Oothecae (*Egg Capsules*) of Some Common Cockroaches

by H. O. Deay

1) Ootheca curved in an inverted half-moon shape; usually contains 16 eggs on each side. Normally found out of doors under bark of old logs and stumps... Pennsylvania Woods Roach

1') Ootheca straight, at least on the bottom side. Normally found in buildings.....2

2) Ootheca one-fourth inch (or less) in length; no more than 9 eggs on each side..... Brown-banded cockroach

2') Ootheca one-third inch or more in length.....3

3) Ootheca slender, about one-third inch long; light brown. Top and bottom sides parallel; contains 12 to 24 eggs on each side. Carried by the female until a day before hatching..... German cockroach

3') Ootheca purse-shaped, not slender; length greater than one-third inch; dark brown to black.....4

4)* With 8 eggs on each side.....

Oriental cockroach

or

American cockroach

4')** With 12 eggs on each side...

Smoky Brown cockroach

* The oothecae of these species are quite difficult to separate with accuracy.

** The ootheca of the brown cockroach may key out at this point. It is difficult to distinguish between oothecae of these two species.

*Correspondence Course Editorial Committee: Dr. John V. Osmun, Dr. Howard O. Deay, William L. Butts, Dr. Philip J. Spear, Dr. Harry D. Pratt, George L. Hockenyos, and James A. Nelson.

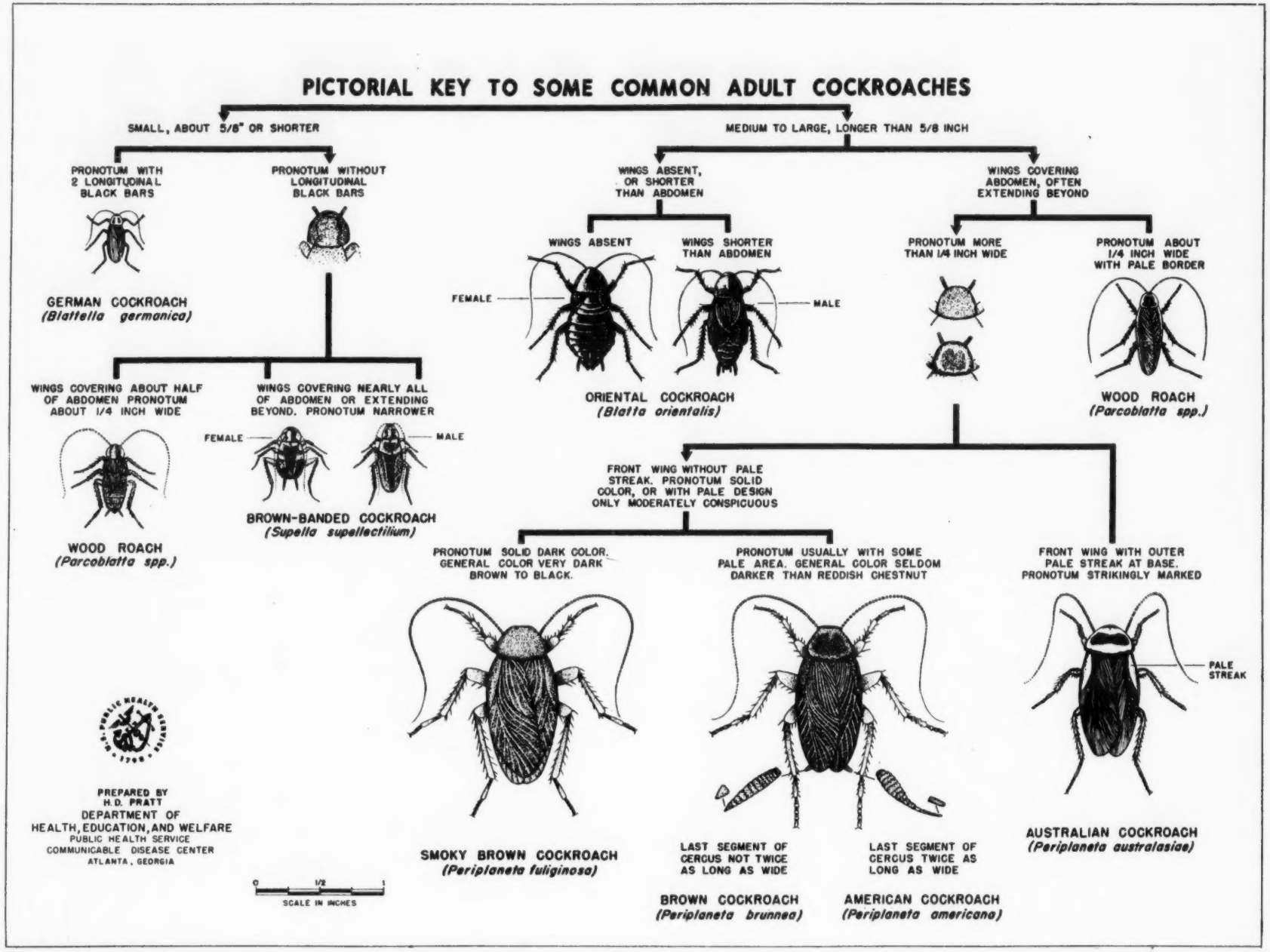
PICTORIAL KEY TO SOME COMMON ADULT COCKROACHES
SMALL, ABOUT 5/8" OR SHORTER
MEDIUM TO LARGE, LONGER THAN 5/8 INCH
PRONOTUM WITH 2 LONGITUDINAL BLACK BARS
PRONOTUM WITHOUT LONGITUDINAL BLACK BARS
GERMAN COCKROACH
(Blattella germanica)
WINGS ABSENT, OR SHORTER THAN ABDOMEN
WINGS COVERING ABDOMEN, OFTEN EXTENDING BEYOND
WINGS ABSENT
WINGS SHORTER THAN ABDOMEN
FEMALE
MALE
ORIENTAL COCKROACH
(Blatta orientalis)
PRONOTUM MORE THAN 1/4 INCH WIDE
PRONOTUM ABOUT 1/4 INCH WIDE WITH PALE BORDER
WOOD ROACH
(Parcoblatta spp.)
WINGS COVERING ABOUT HALF OF ABDOMEN PRONOTUM ABOUT 1/4 INCH WIDE
WINGS COVERING NEARLY ALL OF ABDOMEN OR EXTENDING BEYOND. PRONOTUM NARROWER
FEMALE
MALE
BROWN-BANDED COCKROACH
(Supella supellectilium)
WOOD ROACH
(Parcoblatta spp.)
FRONT WING WITHOUT PALE STREAK. PRONOTUM SOLID COLOR, OR WITH PALE DESIGN ONLY MODERATELY CONSPICUOUS
PRONOTUM SOLID DARK COLOR. GENERAL COLOR VERY DARK BROWN TO BLACK.
PRONOTUM USUALLY WITH SOME PALE AREA. GENERAL COLOR SELDOM DARKER THAN REDDISH CHESTNUT
FRONT WING WITH OUTER PALE STREAK AT BASE. PRONOTUM STRIKINGLY MARKED
PALE STREAK
SMOKY BROWN COCKROACH
(Periplaneta fuliginosa)
LAST SEGMENT OF CERCUS NOT TWICE AS LONG AS WIDE
LAST SEGMENT OF CERCUS TWICE AS LONG AS WIDE
BROWN COCKROACH
(Periplaneta brunnea)
AMERICAN COCKROACH
(Periplaneta americana)
AUSTRALIAN COCKROACH
(Periplaneta australasiae)
PREPARED BY
H.D. PRATT
DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
COMMUNICABLE DISEASE CENTER
ATLANTA, GEORGIA
0 1/2 1
SCALE IN INCHES

Figure 6-B

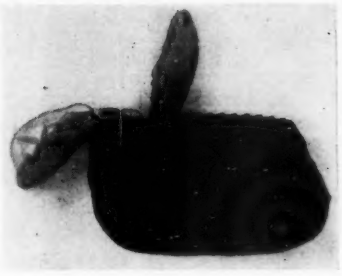

Figure 6-C. Nymphs of the American cockroach escaping from the ootheca. (*Photo by G. E. Gould*). From Gould and Deay.

a seam along the top of the egg case to escape. (See Figure 6-C.) They resemble the adult but do not have wings or wing pads and frequently have a somewhat different color. Nymphs undergo a series of molts and, with the last molt, wings are fully formed and the sexes are easily distinguishable.

Wings of the adults may be long and functional or may be short or almost non-existent. In some species males are winged, but the females have only rudimentary wing pads. Adults may fly or not depending on the species and upon environmental factors.

Most cockroaches are nocturnal, that is they are most active at night, but some species may be seen easily in the daytime, particularly where there is a heavy population. Since most roaches are originally of tropical origin, they still prefer warm moist situations in which to live. Cockroaches usually choose to live in protected cracks and crevices where they sometimes gather in great numbers, although some, such as the American and the oriental roaches, will gather in large groups on open walls in protected places and in open areas outside.

CHARACTERISTICS OF ROACHES

In the following sections, information concerning life history and behavior will be given for a number of the more important cockroach pests. In consulting other literature, it may appear that there are discrepancies in the statements concerning the time required for completion of the various life stages. These differences are not mistakes on the part of the people who have compiled the records, but are actual differences which may be due to a number of factors. One of the most important of such factors is the temperature at which the roaches are reared. Within the limits of the upper and lower thermal death points, cockroach development is generally more rapid at high temperatures and slower at low temperatures.

GERMAN COCKROACH
Blattella germanica (Linnaeus)

The German roach is the most common roach in houses in the United States. In some areas it is referred to as the "croton bug." Adults are pale brown and about ½-inch long; both sexes have wings as long as the body, and can be distinguished from other roaches by the two dark stripes on the pronotum. (See Figure 6-B.)

The female carries its egg capsule protruding from her abdomen until the eggs are ready to hatch. The nymphs may break open the capsule while it is still attached to the female, or she may deposit the capsule in some protected place where the young will be able to find food when they hatch. This is the only common house infesting species which carries the egg capsule for such an extended period of time. Capsules removed from the female more than a day before time to hatch do not hatch. A female will usually produce 4 to 8 capsules in her lifetime.

Each capsule contains 30 to 48 eggs which hatch out in about 28 days at ordinary room temperature. Very young nymphs are dark grey with a light area in the center of the pronotum, but as they grow older, they become more nearly the darker color of an adult roach with the two characteristic black bars on the pronotum. (See Figure 6-D.) The completion of the nymphal stage under room conditions requires 40 to 125 days. German roaches may live as adults for as long as 303 days.

It is stated above that the German cockroach is the most commonly encountered of the house infesting species in the United States. The reasons for this are somewhat complex, but the understanding of some of the factors involved are basic to the practice of pest control.

In the first place, the German cockroach has a larger number of eggs per capsule and a shorter hatching time than do the other species. It also requires a shorter period from hatching until sexual maturity, so that within a given period of time a population of German roaches will produce a larger number of eggs. On the basis of this fact, we can state that this species has a high *reproductive potential*.

Since the female carries the egg capsule during nearly the entire time that the embryos are developing within the egg, many hazards of the environment which may affect the eggs are avoided. This means that more nymphs are likely to hatch and that a larger portion of the *reproductive potential is realized*.

Figure 6-D. A nymph of the German cockroach. Note the light stripe which runs lengthwise down the top of the thorax. This stripe is a medium tan in color and is set against a black background. This characteristic will distinguish the nymph of this cockroach from those of other common house-infesting species.

The nymphs which hatch from each egg capsule tend to stay close to each other, and since they are often close to the female at time of hatching, there is a tendency for the *population density* to be high locally. Being smaller than most of the other roaches, they are able to conceal themselves in many places which are inaccessible to individuals of the larger species.

All of these factors combined help to give the German cockroach an advantage with regard to *group survival*.

The "rapid turnover" in such a population might be expected to be of some significance in the speed with which the population shows response to external selective factors. This appears to be the case in the development of resistance to insecticides. During the time in which chlordane and DDT have been selecting for resistance in cockroach populations there has been a larger number of generations of the German cockroach exposed. This undoubtedly helps to explain the widespread occurrence of resistance found in this species.

The German roach is very active. Both the male and the female adults are fully winged although they rarely fly. They are regularly carried from place to place in such things as bagged potatoes and onions, bottle cases and cartons, and food packages. They travel readily from one location to another and can pass through very small openings. The pest control operator must look very closely to find all places in which roaches may be living. Places in which the Ger-

man roach is found will generally be characterized by a number of ecological factors. These places will usually be warm, dark and will often provide rather small cracks and crevices or rather small openings into dark, confined areas. Such places will usually be rather moist or will be located near some source of water; they will be close to some sort of food supply.

German roaches usually are found clustered closely together. In populations which have developed a resistance to modern insecticides, however, there is good reason to believe that individuals may scatter widely throughout a building. This scattering results in distribution of individuals which are not easily found and which can breed and build up the roach population again in a short time.

Although the German roach normally is most active at night in dark areas, individuals are often seen out of their normal hiding places in any area where they are not disturbed. When this roach is seen out in the open during the daytime and while there is much activity in the area, it may be concluded that a very heavy population is present.

AMERICAN COCKROACH

Periplaneta americana (Linnaeus)

The American roach is also known as the waterbug, Bombay canary, and the flying water bug. It is the largest of the common species, growing to a length of 1½ inches or more. It is reddish-brown, with a yellowish posterior border on the pronotum. (See Figure 6-B.) Both male and female are fully winged, those of the male usually extending slightly beyond the tip of the abdomen while those of the female are about the same length as the abdomen.

The female drops her egg capsule within a day after it is formed. It may simply be dropped in a suitable location or may be glued to some surface with secretions from her mouth. Egg capsules are formed at the rate of about one per week until from 15 to 90 have been produced. Each capsule contains from 14 to 16 eggs. At room temperature, nymphs will hatch out in 50 to 55 days. In the process of hatching, nymphs will molt, leaving their cast skins in the egg case.

Young nymphs are greyish-brown (See Figure 6-E), and each will molt 9 to 13 times before reaching maturity. The time required for completion of the nymphal stage varies from 160 to 971 days. At room temperature, an adult female will live for an average of about 440 days; males live for a somewhat shorter period.

Figure 6-E. A nymph of the American cockroach. Note the rather even coloration over the body. The presence of a small fleshy pad on the last segment of the tarsus (between the tarsal claws) will distinguish this nymph from that of the oriental cockroach. This characteristic is illustrated by the inset.

American roaches prefer quite warm and moist areas. They are common in food handling establishments and industrial plants. Outdoors, they will live under tree bark and, in the South, in palm trees. In the southern states both males and females have been observed making lengthy flights; however, in the North, they usually have a glide-like flight.

ORIENTAL COCKROACH

Blatta orientalis Linnaeus

The oriental roach is also referred to as the "waterbug," "black beetle," and shad roach. It is found in all parts of the United States.

Total length of this roach is about 1¼ inches in females and about 1 inch in males. The female has small, functionless rudimentary wings while those of the male cover about ¾ of his abdomen. Neither the male nor the female will fly. Adults are very dark brown or black. Females are broader and heavier than males. (See Figure 6-B.)

An egg capsule is carried by the female for about 30 hours after which it is dropped or attached to a protected surface near a food supply. The average female will produce 8 capsules, each containing 16 eggs which will hatch, under room conditions, in about 60 days.

Figure 6-F. A nymph of the oriental cockroach. Note the very even dark coloration of this species. Nymphs vary from very dark brown to black in color with very little gradation of color over the body surface of a single specimen. The inset illustrates the last segment of the tarsus. The absence of a pad between the tarsal claws will distinguish this nymph from that of the American cockroach.

Nymphs molt from 7 to 10 times and the nymphal stage usually requires about one year for completion. (See Figure 6-F.) Unlike the other house infesting species, the oriental cockroach appears to have a definite seasonal periodicity in its developmental cycle. The peak number of adults usually appears in late spring or early summer, but due to natural mortality, the number of adults in the population is generally quite low by late summer and early fall. There are usually a few live adults in the population throughout the year, but if nymphs have not reached maturity by late fall or early winter, their development seems to slow considerably, with maturity not being reached until spring.

In many areas the oriental cockroach spends considerable time outdoors during warm weather. In periods of drought there may be mass movement into structures, apparently in relation to humidity gradients. As cold weather approaches (or sometimes during unseasonably cool periods) a similar indoor migration may ensue in response to temperature. There may be considerable group movement within heated structures during cold weather, particularly in situations in which certain areas of the building are maintained at a higher temperature than are other areas.

BROWN BANDED COCKROACH

Supella supellectilium (Serville)

This is one of the smaller roaches, rarely being more than ½-inch long. It is light brown and can be readily distinguished from the German roach by the presence of two lighter, transverse (running from one side to the other) bands across the base of the wings and abdomen in adults and in the same position on the nymphs. The female is much broader bodied than the male (See Figure 6-B). Both male and female are quite active and the adult males fly readily when disturbed. Both adults and nymphs may jump when attempting to escape. They frequently occur in the same buildings as the German roach and the pest control operator

must be very careful to identify the species he is dealing with since the method of control is quite different for each.

A female carries her egg capsule for a day or two and then attaches it to a protected surface. Each female will produce about 14 capsules during her adult life, each containing about 18 eggs. These hatch in 50 to 75 days, depending on temperature.

Under room conditions, nymphs mature in about 160 days. (See Figure 6-G).

Figure 6-G. A nymph of the brown banded cockroach. Note the two light colored banded running crosswise on the body. These bands are a very light tan in color and are set against a dark brown background. This characteristic is used to distinguish the nymph of the brown banded cockroach from those of other species.

This roach originally occurred only in the southern states but is now found as far north as Canada. Although this roach may be encountered in practically any place in a structure in the southern states, it is more generally found in the warmer parts of buildings in the cooler northern region. It is most active at temperatures above 80°F., showing a definite slowing down of both activity and development at temperatures under 75°F.

AUSTRALIAN COCKROACH
***Periplaneta australasiae* (Fabricius)**

The Australian roach is similar in appearance to the American roach but is rarely more than 1¼ inches long. It is reddish brown and can be distinguished by a prominent yellow stripe along the outer front edge of its wings and by a prominent dark spot in the center of the pronotum (See Figure 6-B).

An adult female drops her egg capsule shortly after it is formed. The eggs hatch in about 30 days after the egg capsule is dropped. There are approximately 24 eggs per capsule, but only about ⅔ of this number usually hatch. Egg capsules are completed and dropped at about 10-day intervals.

The nymphs are strikingly marked with distinct splotches of yellow on the dorsal side of the thorax and abdomen.

This is chiefly a southern roach but has been found in greenhouses and houses in the northern states. It feeds predominantly on plant materials, although it will feed on starchy materials such as book covers in homes.

SMOKY BROWN COCKROACH
***Periplaneta fuliginosa* (Serville)**

Smoky brown roaches are closely related to the American roach but can be distinguished from it by their smaller size, being slightly more than 1 inch long, and by their uniform mahogany color. Both males and females have wings longer than their bodies. (See Figure 6-B.) Common in the southern states, it is widely distributed from central Texas eastward and has been found in isolated locations as far north as Iowa and Indiana. It is normally a plant feeder, being a common pest in greenhouses, but has been found in homes and other buildings in many areas.

The egg capsule normally contains 24 eggs. A female carries her capsule for 24 to 36 hours and then attaches it in some secluded location. Each female produces about 17 capsules.

BROWN COCKROACH
***Periplaneta brunnea* Burmeister**

Brown roaches are generally distributed in the southern states from Florida to Texas. They have been found as far north as Philadelphia, Pennsylvania and Columbus, Ohio.

It resembles the American roach but is broader in relation to length, and it has slightly less distinct markings on the thorax. The last segment of the cercus is short and broad as illustrated in the key (Figure 6-B). They occur indoors as well as outdoors where they are found under the bark of trees, and in sewers as well as other similar places.

Egg capsules contain an average of 24 eggs each.

WOODS COCKROACHES
***Parcoblatta* spp.**

The term woods roach is used to cover a group of roaches, usually of the same genus and having similar habits. The species most generally described is the Pennsylvania woods roach, *Parcoblatta pennsylvanica* (DeGeer). Woods roaches are small, usually being not more than ⅔ inch long. Adults are dark brown with the sides of the thorax and the front half of the wings margined with yellow. In the male, the wings are longer than the body, while those of the female cover only ⅓ to ⅔ of the abdomen (See Figure 6-B).

Males are good fliers and are frequently found flying around street lights at night. Woods roaches normally live outdoors but may wander inside from time to time and are frequently brought into houses with loads of firewood. The eggs and nymphs do not usually develop inside buildings.

FIELD COCKROACH
***Blattella vaga* Hebard**

This is a small roach, slightly smaller than the German roach; it can be distinguished from it by a blackish area on the front of the face extending from the mouth parts to between the eyes. Its distribution is from California to Texas. The field roach feeds largely on decomposing vegetation and is common in irrigated areas. During dry parts of the year it sometimes wanders into homes. Normally it can be found under stones, clumps of earth and similar locations.

LOBSTER COCKROACH
***Nauphoeta cinerea* (Olivier)**

Adult lobster roaches reach a length of 1¼ inches. The wings of males are slightly longer than those of females which do not cover the abdomen. This species can be distinguished by a lobster-like design on the pronotum. The egg case contains from 26-40 eggs.

This is a southern species being known principally from Florida where it has become established in some food handling establishments.

COCKROACH DAMAGE

Frequently the presence of cockroaches may be detected by the damage they do or by the fecal matter deposited. These are clues, and just as symptoms are useful to a doctor in diagnosing a disease, so will clues aid you in diagnosing your roach problem. Cockroaches may utilize such things as glue, paste, starch, and certain color dyes as foods. As a result, such things as stamps, envelopes, book bindings (Figure 6-H), draperies, and certain wallpapers may show signs of feeding. The size of the mandible marks and the apparent degree of vigor with which they feed are indications of the type of roach which did the damage. In a

Figure 6-H. A book binding which has been extensively damaged by the feeding activities of oriental cockroaches. Note dark blotches of fecal matter and pulled effect on exposed fabric.

similar manner, the size and shape of fecal droppings are clues to the roach involved. The following descriptive table may be used to help determine the roach which did the damage:

A. Surface of material roughened from chewing, the roughness having been caused by pulling action. Distinct tooth marks as in mouse damage are lacking, but indication of mandible activity present. Fecal pellets may be nearly as large as those of a mouse, but with 6 more or less distinct longitudinal ridges and blunt ends. Fecal deposits may not be pelleted, but simply dark smears or stains.
. . . . . Large roaches (e.g., American, oriental)

B. Surface of material showing feeding but only slightly roughened or not at all. Feeding trails may be long and irregular. Fecal deposits, when pelleted, are small and usually numerous. Ridges difficult to see.
. . . . . Small roaches (e.g., German, brown-banded)

COCKROACH CONTROL

THE CONTROL of roaches requires a great deal of care and planning on the part of the operator. It is necessary for him to search closely for their hiding places and to treat them thoroughly. Regardless of the type of insecticide used, chemicals placed in or near regular hiding places will give better control than those placed where roaches will only walk over them occasionally. In the control of many species, good sanitation is fully as important as the use of chemicals. The pest control operator should work very closely with his customer to see that all possible sources of food supply are removed.

Control chemicals may be oil-based sprays, water emulsion sprays, dusts, and, for some species, baits. Choice of chemical frequently depends on the situation to be treated. Obviously, dusts cannot be used where they would be unsightly. On porous surfaces, oils will penetrate deeply and leave less residual insecticide on the surface than will a water emulsion. Usually a residual chemical is to be preferred for roach control, but, in many instances, it may be necessary or desirable to use a contact spray. Frequently a combination of residual insecticide together with a contact insecticide is used. Common residual insecticides, applied as either oil based sprays or water emulsions, are: 2% malathion, 0.5% Diazinon, 2% ronnel, 0.5% dieldrin, 1% Dipterex, 1% dicapthon, or 2% chlordane. A combination of approximately 0.5% DDVP and 0.5% Diazinon is also being used for control of resistant roaches. The vapor toxicity of DDVP is useful to some extent in reaching roaches not readily accessible to direct contact.

Some common direct contact knockdown insecticides are pyrethrum, combinations of pyrethrum with various synergists, Lethane, and Thanite. These contact sprays will irritate insects, causing a very rapid response. For this reason they are frequently used in the pest control industry for flushing insects from their hiding places, thus locating the focal points of the infestation.

Chemical dusts often used are sodium fluoride, pyrethrum, and combinations of these toxicants. Dust formulations containing 1% Diazinon, 5% chlordane, or 1% dieldrin are also used. Silica aerogels, either alone or in combination with insecticides are also available.

Power sprayers, mist blowers, and thermal fog machines may all be used for roach control. Inside structures, however, a hand operated compressed air sprayer is most commonly used. To apply a residual over a general surface, a fan or cone nozzle should be used. Generally, it is most desirable to force the insecticide into cracks and crevices where roaches hide; this is most easily done with a fine pin-stream nozzle.

Dusters most commonly used in roach control are small rubber bulb or bellows type hand dusters. Such dusters are designed so that a small amount of dust can be placed in narrow cracks and crevices. For a more complete description review the section on dusters in Lesson Five.

GERMAN COCKROACH CONTROL

The German roach is usually found near a good source of water and food. Check places such as cracks and crevices, under the tops of tables, behind sinks, in cabinets, the motor compartments of refrigerators and soft drink dispensing machines, underneath the bases of kitchen equipment which are set on the floor, in switch boxes and fuse boxes, underneath cafeteria counters and soda fountains, in cash registers, in vegetable bins, around meat counters and check-out stands, under meat cutting blocks, and almost anywhere else where conditions are favorable. It is obviously impossible to list all places where the German roach may live, so the operator must look thoroughly to be sure to find all resting places similar to those mentioned.

Because German roaches have become quite resistant to most chlorinated hydrocarbon insecticides, other chemicals are required to give residual control. Most frequently used are Diazinon, malathion, and ronnel. DDVP has been used recently for cockroach control. It is an excellent material insofar as initial kill in concerned, combining contact activity with vapor toxicity. Its residual life is rather short. Recently the first proven cases of phosphate resistant German cockroaches have been noted. A population of Diazinon resistant cockroaches found in Owensboro, Kentucky has been controlled with malathion. Populations of the German cockroach which are resistant to pyrethrum are also known.

To apply a chemical to broad surfaces, use a flat fan nozzle. Most spray applications, however, will be made to narrow cracks and crevices where it is necessary to drive the chemical into roach hiding places. For this application, use a fine pin stream nozzle and aim the insecticide as directly into the crack as possible. The angle at which the spray is applied is most important since the greater the angle of spray away from the crack, the less insecticide will penetrate deeply into it. It is not necessary to have the sprayer pumped to a high pressure. Any pressure from 15 to 40 pounds is adequate.

Where it is necessary to spray near dishes, glassware, or cooking utensils, cover them with material such as sheet polyethylene or a clean cloth before spraying and be sure not to contaminate any of them with insecticide.

Toxic dusts may give longer lasting control than will sprays, especially where dusts can be applied to dry areas. Diazinon, pyrethrum, sodium fluoride, a combination of sodium fluoride and pyrethrum, or silica aerogels are most commonly used. These can be applied with power dusters or plunger dusters, however, the most common type used by pest control operators is the hand operated bellows or rubber bulb duster.

Two dusting techniques are in general use. Some operators use a heavy application of dust to fill the crevices where roaches may be hiding. This technique is called "lining." Others use a fine application to deposit a thin film of dust that roaches will walk through and thus pick up insecticide on their bodies. The heavy application is suitable where it will not create an unsightly condition; however, it is generally better to make a light application. Cockroaches commonly clean their appendages with their mouthparts, so even small amounts of the toxicants may be taken internally where they will act as stomach poisons.

To lay a thin film of dust, hold the nozzle of the duster upwards and shake it to make the dust float inside the duster; then squeeze lightly, forcing a very fine mist of dust out of the nozzle. Hold the nozzle close to the area to be treated and force the dust into the cracks and crevices where roaches are hiding.

All dusts float in the air as they are applied. The operator must be very careful to keep the quantity of this air borne dust to a minimum since it not only can contaminate food and food products but is also hazardous when breathed into the lungs.

With either liquids or dusts, the pest control operator must have a clean rag in his hand to wipe up immediately any materials which would be dangerous or unsightly.

AMERICAN COCKROACH CONTROL

These large roaches are to be found in dark, damp, warm places and frequently congregate in colonies in more or less open spaces rather than in cracks and crevices. They are often found near steam pipes, in sewers, grease traps, damp basements, and similar places.

American roaches can be controlled by the use of sprays, dusts, or baits. Since they have not developed a general resistance to insecticides, such materials as DDT, lindane, and chlordane can be used to control them. These materials are generally preferred over the phosphate insecticides since they will usually have a longer residual life. Residuals placed in areas which they inhabit will kill American roaches slowly but effectively. They can also be killed by spraying them directly with residual sprays or with the usual knockdown insecticides.

These roaches will also feed on sugar base Dipterex. A paste containing 2% phosphorus is frequently used for the control of American roaches. This bait material need not be placed in the immediate area where roaches congregate since they will travel as much as 50 feet to find the bait. Phosphorous paste is very toxic, and extreme care must be used to be certain the paste is not placed anywhere children or pets might have access to it. Care should be taken, also, not to place it on hot pipes or other locations which might create a fire hazard. Phosphorous paste is not always attractive, so test baiting should be employed before an extensive application is made.

ORIENTAL COCKROACH CONTROL

Oriental roaches prefer quite moist situations when they live indoors and are frequently found in areas such as under porches, in crawl spaces, and in floor drains. They may be found outdoors in abandoned cisterns, valve pits, and in garbage and trash dumps. They can be controlled with the same residual chemicals and contact sprays used for the American roach. They will also feed on Dipterex sugar baits, and some pest control operators have had good success with the use of phosphorous paste, although the latter may give inconsistent results.

Because oriental cockroaches often move into dwellings in large numbers, a barrier treatment is often used for their control. The ground immediately around a building and the foundation can be treated with either a spray or dust application of chlordane, DDT, or dieldrin.

BROWN BANDED COCKROACH CONTROL

Brown banded cockroaches, with their preference for very warm temperatures, are found widely dispersed usually in houses and only infrequently elsewhere. They are difficult to control with either direct sprays, residuals, or by dusting because they frequently live as individuals scattered all over the premises.

When applying sprays or dusts, such places as inside bureaus, shelves in clothes closets, ceiling light fixtures, and valances above windows must all be treated carefully. The operator must learn to know their hiding places, and there is no substitute for a thorough inspection of the premises.

Many operators use contact insecticides in mist machines or high output lindane vaporizers to treat the whole area inside a house. When using this technique, be sure to open all drawers and closet doors so the chemicals will have a better chance to reach the places where roaches are hiding. The building must be kept closed for several hours after application to assure adequate control.

CONTROL OF OTHER COCKROACHES

Field Cockroach

Field roaches are found living on decomposing vegetation and under stones and clumps of earth. They come into homes only during drier portions of the year to get moisture and can usually be controlled by removing decomposing plant material from the area, or when necessary, by spraying or dusting direct contact insecticides.

Smoky Brown Cockroach, Australian Cockroach and Brown Cockroach

These roaches can be controlled with the usual contact sprays or dusts in the same manner as the American roach.

Woods Roaches

Woods roaches are usually only casual invaders of houses. Because they are strong fliers, they are very difficult to control with sprays or dusts inside the house. At times they may be numerous in crawl spaces under a house, and in such a situation, a thorough spraying or dusting will be effective. Woods roaches are common in woodpiles, so storage of firewood some distance from the house will frequently reduce their numbers inside.

Next Month:

Ants and Other Hymenopterous Pests

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Infestation Report

Contains pertinent portions of the Department of Agriculture's Cooperative Economic Insect Report, material from university entomology departments and reports from readers. PCOs noticing infestations in their own areas are urged to communicate with *Pest Control* so their information may be added to this infestation report.

ANOBIIDS

Connecticut: *Ptilinus ruficornis* caused some damage in a house in Fairfield County. **Utah:** Larvae of unspecified species numerous in floor joists in a building in Corinne, Box Elder County.

IMPORTED FIRE ANT
(*Solenopsis saevissima richteri*)

Florida: Initially discovered in St. Johns County, adjacent to infestation in southern portion of Duval County.

ODOROUS HOUSE ANT
(*Tapinoma sessile*)

Oklahoma: Winged forms noted in annoying numbers in a home in Miami, Ottawa County.

BEDBUG
(*Cimex lectularius*)

Connecticut: Infesting certain poultry houses in New Haven and Windham Counties. **South Dakota:** Infesting a home in Davison County

CARPET BEETLE
(*Anthrenus scrophulariae*)

Alabama: Light infestation on corn meal in a warehouse at the Alabama State Docks. This corn meal was being shipped to Ghana and other places overseas.

CONFUSED FLOUR BEETLE
(*Tribolium confusum*)

Oklahoma: Counts averaged 6 per quart in stored grain sorghum surveyed on a farm in Marshall County. **South Dakota:** Found to be a problem in a home in Brookings County this week.

SAW-TOOTHED GRAIN BEETLE
(*Oryzaephilus surinamensis*)

Delaware: Heavy infestation in cereals and flour in home in New Castle County. **Oklahoma:** Counts averaged 27 per quart in stored grain sorghum surveyed on a farm in Marshall County. **Virginia:** Common in some rockwool sent in from Rockingham County. The reason for their being there is unknown.

SPIDER BEETLES

New Mexico *Ptinus clavipes* and *Niptus ventribulus* adults numerous on paper feed sacks in storage sheds at Elida, Roosevelt County.

A BAMBOO BORER
(*Dinoderus minutus*)

California: Heavy infestation in bamboo furnishings in Modesto, Stanislaus County.

LESSER GRAIN BORER
(*Rhyzopertha dominica*)

Texas: Moderate infestation in stored milo in Guadalupe County.

BOXELDER BUG
(*Leptocoris trivittatus*)

South Dakota: Numerous in most areas in eastern section of State. **Utah:** Troublesome in and about school rooms at Salt Lake City, Murray and Ogden in northern area of State. **Virginia:** Common around home in Farmville, Prince Edward County.

ORIENTAL COCKROACH
(*Blatta orientalis*)

Maryland: Causing concern in and around homes in Frederick and Prince Georges Counties. Nymphs and adults present in homes at localities in Montgomery County. **Utah:** Infesting home at Pleasant Grove, Utah County. Encountered more frequently than ten years ago. Troublesome in a number of Davis County homes, being more common at Bountiful.

COCKROACHES

Maryland: *Periplaneta americana* present in homes at localities in Montgomery County. **Utah:** *Blattella germanica* severely infesting commercial building at Salt Lake City. They are encountered less frequently, but *Supella supellectilium* are more frequently encountered than ten years ago. *Periplaneta americana* is a problem occasionally.

A BLOOD SUCKING CONENOSE
(*Triatoma protracta woodi*)

California: Occurring in houses and dwellings in Death Valley, Inyo County.

EARWIGS

Nevada: Adults of *Forficula auricularia* active in Reno, Washoe County. **Utah:** Encountered in home gardens in Salt Lake and Weber Counties. (Knowlton).

FACE FLY
(*Musca autumnalis*)

Nebraska: Specimens sent in from Pierce County for identification. This is the most western occurrence known in the State. **Virginia:** Collected from Independence, Grayson County. This is a new county record.

A BEE MITE
(*Acarapis dorsalis*)

Nebraska: Found during past winter inhabiting external areas of honey bees collected in Lancaster County. This is first report of this mite in the State.

CASEMAKING CLOTHES MOTH
(*Tinea pellionella*)

North Dakato: Severely damaged rolled carpeting stored in a Fargo home.

CLOVER MITE
(*Bryobia praetiosa*)

Arizona: Heavy infestations a problem around homes in northern part of State, particullay in Page area of Coconino County and in Phoenix area. **California:** Heavy on outside of barn and invading residence in Herlong, Lassen County; heavy in residence in Julian, San Diego County. **Delaware:** Several heavy infestations occurred in homes in New Castle County. **Idaho:** Having many calls in Boise homes. **Maryland:** Troublesome in and around homes in Baltimore, Montgomery and Prince Georges Counties. **Nevada:** Large numbers invading homes in Reno-Sparks, Washoe County. **New Jersey:** Very active about homes. **North Carolina:** Invading 5-year-old brick house in Union County. **North Dakota:** Entering several homes in Fargo. **Utah:** Entering a number of homes in Weber County. Invading many homes in Salt Lake and Davis Counties. **Virginia:** Extremely abundant and crawling in home near Ettrick, Chesterfield County. **Wyoming:** Infesting homes and lawns in many towns in Big Horn Basin.

MOSQUITOES

California: Larval occurrence reports show slight decrease in populations, except in northern area where an abrupt drop occurred. Occurrence of *Culex tarsalis* has been very low in all areas. **Delaware:** Second- and third-instar larvae of *Aedes excrucians* collected from woodland pool at Coochs Bridge, New Castle County. This is a new State record. (Lake). *Aedes vexans* was collected as fourth-instar larvae in New Castle County. This was the first collection of the season. **Iowa:** Overwintering *Culiseta inornata* beginning to appear. **Maryland:** Larvae of *Culiseta melanura* abundant in a stumphole filled with spring water near Ft. Meade, Anne Arundel County. **Nebraska:** Some adult activity of unspecified species in Lincoln, Lancaster County. **Nevada:** Adults of *Aedes niphadopsis* very abundant in Fallon, Churchill County, Fernley, Lyon County, and Gerlach, Washoe County. *A. schizopinax* adults moderately abundant in Gerlach area. *A. campestris* and *A. dorsalis* mostly in third and fourth instars in Churchill, Lyon and Washoe Counties. Adults of *Culex erythrothorax* have emerged. **Texas:** In Jefferson County, trap catches increased greatly. Mosquitoes are about twice as numerous at present as one year ago. *Culex* spp. (mostly *salinarius*) most numerous in Port Arthur area. *Aedes vexans* appeared in North Beaumont light traps. Landing rate observations showed a high incidence of mosquitoes at Port Arthur. **Virginia:** Light, spotted infestation of third- and fourth-instar larvae and pupae of *Aedes sollicitans* in Norfolk-Portsmouth area. First known infestation of year in area.

INDIAN-MEAL MOTH
(*Plodia interpunctella*)

New Mexico: Larvae infesting stored pecans at Mesilla, Dona Ana County. **North Carolina:** Infestation in a grocery stored in Cherokee County.

PSYCHODIDS

North Carolina: Biting man loccally in Mecklenburg County.

LARGE BROWN RATS

Oklahoma: Large brown rats are thriving at Swan Lake, 17th Place and Utica Ave., health department officials reported to the city park department.

BROWN-BANDED ROACHES

Idaho: Two new infestations found in Boise homes.

WESTERN SUBTERRANEAN TERMITES
(*Reticulitermes hesperus*)

Nevada: Numerous infestations reported in the Reno-Sparks area, Washoe County. **Oregon:** Winged forms reported from several counties during March.

TERMITES

Connecticut: *Reticulitermes flavipes* swarming in a school in Tolland County; workers also attacking growing geraniums in a Hartford County greenhouse. **Delaware:** Spring flights of undetermined species continue very numerous. **Indiana:** Spring swarming flights of *Reticulitermes* sp. reported in Goshen, Elkhart County. **Maryland:** Winged forms of *R. flavipes* noted in and around homes at localities in 5 counties. Also noted in homes at Baltimore and in Prince Georges County. **Oklahoma:** *R. tibialis* noted swarming in central, east central and northeastern areas. **Pennsylvania:** Adults of unspecified species noted swarming in a home, a greenhouse and a bank building in Centre County and in a home in Clearfield County. **Utah:** *Reticulitermes sp.* damaging additional homes in Salt Lake City-Sandy area of Salt Lake County and a school building at Logan, Cache County. **Wisconsin:** Alates reported as being recovered in office building in Superior, Douglas County, have been determined as *Reticulitermes flavipes* by T. E. Snyder.

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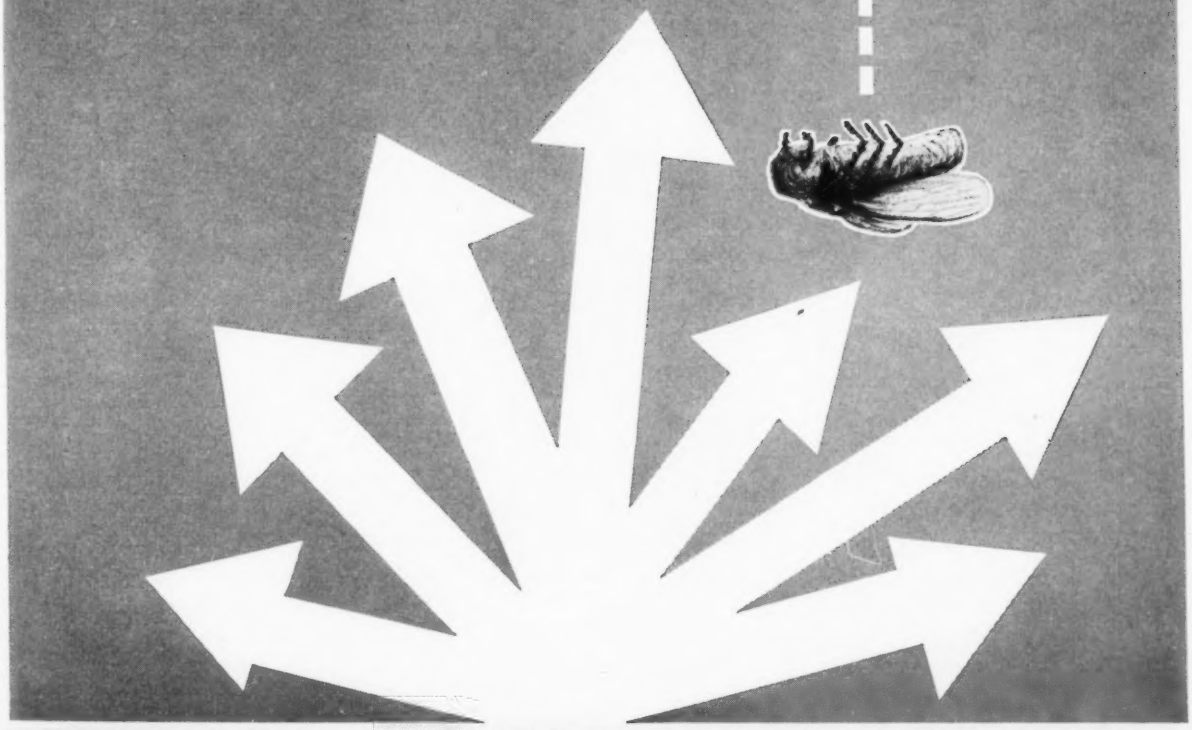

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New and Current Insecticides for German Cockroach Control

By G. S. BURDEN and B. J. SMITTLE

Entomology Research Division, Agricultural Research Service, U. S. Department of Agriculture, Beltsville, Maryland

CONTROL OF GERMAN cockroaches (*Blattella germanica* (L.)) in homes and business establishments has become a problem requiring diligent and concentrated efforts to achieve maximum reduction. Several organophosphorus insecticides are being employed extensively as sprays or dusts; however, a search is constantly in progress to find newer and more persistent insecticides to combat the increasingly resistant populations that are continually developing. Information presented herein shows the results of field research programs conducted in Florida with new and current insecticide formulations against natural infestations of German cockroaches.

Recent investigations were conducted with emulsion and oil sprays containing 1% of Bayer 29493 (*O,O*-dimethyl *O*-(4-methylthio-*m*-tolyl) phosphorothioate), a dust containing 3% of Bayer 29493, and a dust containing 2% of Diazinon (*O,O*-diethyl *O*-(2-isopropyl-4-methyl-6-pyrimidinyl) phosphorothioate).

Two-gallon pressure sprayers fitted with Teejet No. 8002 flat spray tips and 1-quart pistol-type sprayers fitted with pin-stream nozzles were used for application of the sprays as spot treatments. The dust applications were made with bulb-type dusters fitted with extension nozzles so the insecticide could be blown into cracks and other hard-to-reach areas.

Prior to treatment, thorough inspections were made in cockroach-infested homes to determine the magnitude of the populations and the harborages. The effectiveness of the insecticidal treatments, expressed as the percent reduction in live cockroaches, was based on a comparison of pre- and post-treatment counts made throughout a period of 90 days.

Results of these tests are shown in Table 1. The emulsion and oil sprays of Bayer 29493 gave reductions of 93% or greater during the first 2 months and 80% to 84% after 3 months. Odor of the sprays was of minimum perception and staining was not evident in any of the treated buildings. These tests indicated the effectiveness of 1% Bayer 29493 sprays to be comparable with that of 0.5% Diazinon, 2% malathion, and 2% ronnel sprays as reported by Burden *et al.* (1960) and Lofgren *et al.* (1957).

Reductions produced by the dust containing 2% of Diazinon were very satisfactory and superior to those obtained previously with 1% of Diazinon, 4% of malathion, or 4% of ronnel (Burden *et al.* 1960). The Bayer 29493 dust gave 88% to 91% reduction the first month, then gradually lost its effectiveness.

In an attempt to increase the percent reduction of live cockroaches or extend the period of effectiveness of treatments, additional tests were conducted employing combinations of sprays and dusts in infested homes. The treatments consisted of 0.5% Diazinon emulsion spray in combination with a 2% Diazinon dust in one group of homes and a 2% malathion emulsion spray in combination with a 2% Diazinon dust in a second group of homes. In each group, spray applications preceded dust applications.

As shown in the table, this type of treatment almost completely eliminated German cockroaches throughout the 90-day test period and was better than any of the sprays or dusts applied separately. The higher reductions in cockroach infestations and subsequent increase in protection time obtained should be adequate compensation for the slight increase in operation time and materials required for the combination treatments.

Table 1. Control of German cockroaches in homes with various insecticides applied as sprays and/or dusts. (3 to 6 replications per treatment.)

Treatment	Pretreatment count (average)	Percent reduction after indicated days						
		6	13-14	21-22	29-30	42-44	61	90
1% Bayer 29493 emulsion spray	396	98	98	97	98	98	93	84
1% Bayer 29493 oil spray	323	93	95	97	97	96	94	80
3% Bayer 29493 dust	198	90	88	90	91	83	80	39
2% Diazinon dust	636	95	95	91	98	96	95	90
0.5% Diazinon emulsion spray plus 2% Diazinon dust	215	99	99	99	99	100	100	100
2% malathion emulsion spray plus 2% Diazinon dust	97	99	99	99	99	99	99	100

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Burden, G. S., and J. L. Eastin. 1960. Field tests of dusts and sprays against German cockroaches. Fla. Ent. 43(1): 15-8.

Lofgren, Clifford, G. S. Burden, and P. H. Clark. 1957. Experiments with insecticides for the control of German roaches. Pest Control 25(7): 9-10, 12, 47.

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Keeping GERMAN Cockroaches Out of Beer Cases

By
ARNOLD MALLIS
W. E. ESTERLIN
A. C. MILLER
Gulf Research & Development Co.
Pittsburgh, Pennsylvania

IN OCTOBER 1959, a large modern brewery in the East asked for help in solving a German cockroach problem that was causing them serious trouble. The problem was this: cockroaches were being shipped into the brewery in returnable cartons, and then were being shipped out to its customers in the refilled cartons. Apparently the brewery had received many complaints and was seriously concerned.

The problem of cockroach infestation in returnable beer cartons had become acute during the summer of 1959 for two reasons. One, it was a long, hot summer, above the average in the number of warm, humid days which favored cockroach populations. Two, German cockroaches were showing widespread resistance to chlordane. Therefore, the pressure of a build-up in the number of cockroaches combined with the less satisfactory control in the taverns resulted in the acute cockroach problem.

An inspection of the brewery showed it to be modern in every respect, with excellent sanitary facilities. An experienced pest control company regularly serviced the brewery and its warehousing areas, and apparently was doing a good job. The PCO, of course, had no control of cockroaches being shipped into the plant with used beer cartons.

An examination of the beer cartons, which were made of heavy cardboard, showed they contained numerous crevices, especially in the tunnel-like folds of the flaps, which made excellent hiding places for the German cockroaches. It was evident that these cases had not been designed with the view of keeping cockroaches out of them.

An examination of the facilities in the brewery for treatment of the used beer cartons showed cartons to be carried on a continuous conveyor system from a warehousing area beneath to the bottling floor above. As the carton came up the conveyor belt, the flaps of the carton were automatically spread open from the center of the carton. Then a trip mechanism permitted a spot of spray (pyrethrins-synergist) to hit the center of the carton. Since this spot of spray was only a few inches in diameter and sprayed only a small area in the center of the carton, it was apparent that it was not doing the job it was supposed to do, and very evidently was not spraying the cockroaches in the folds of the two flaps.

The warehousing facilities, where empty cartons were stored on pallets, showed the pallets to be surrounded by a ring of insecticidal dusts placed there by the PCO which undoubtedly helped to reduce the roach population.

An inspection was made of the loading platform where trucks were loaded and unloaded. It was quickly evident from an examination of the cartons that German cockroaches were carried in the

Treated carton (right) is compared with an untreated carton by entomologist Easterlin who counts roaches in this experiment with use of repellent. The 32-inch stainless steel ring is greased on inside to confine roaches to the ring.

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Leading P.C.O.'s have found water baiting is more effective with PIVALYN. It's the only water soluble anti-coagulant which combines top acceptability and resistance to mold. With its exclusive properties, PIVALYN has proven to P.C.O.'s that water baiting affords highly successful control.

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empty cartons unloaded from the trucks.

Control Recommendations

Upon conclusion of this preliminary inspection of the brewery and its warehousing and loading facilities, the following recommendations were made to solve the problem of cockroaches being shipped out in refilled cases:

1. Continuation of the pest control service.
2. Redesigning of the carton to remove as many crevices as possible, especially those in the flaps.
3. Spraying the carton with a repellent spray for cockroaches.
4. Use of several nozzles to spray the carton so that the entire inner portion of the carton and its flaps were sprayed.
5. Regular spraying of the trucks after unloading with an oil base spray containing a high concentration of pyrethrins and synergist.
6. Regular spraying of the loading platforms with an oil base spray containing a high concentration of pyrethrins and synergist.

The Container Corporation of America cooperated in redesigning the beer carton so that all unnecessary crevices (roach hiding places) on the inside of the carton and on the flaps were removed. This was, of course, a future solution to the roach problem, but in no way helped solve the problem of cockroaches in the older cartons.

The next step was to obtain a suitable repellent that would keep cockroaches out of the cartons. The brewery told us that during the busy season on the average the cases were out for several weeks, the time depending largely on the weather. We were aware of the work being done by McLaughlin Gormley King Co. with repellents, and on communicating with MGK were told to write to one of its customers who had a repellent formulation that was claimed to be effective against German cockroaches. A quantity of an emulsion concentrate containing 5% MGK R-11 (repellent) and 15% MGK-264 (synergist) was received from this company. The repellent concentrate is diluted one part with 4 parts water to make a 1% R-11 and a 3% MGK-264 emulsion.

Preliminary tests in the ento-

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Pival Concentrate remains the choice of leading P.C.O.'s across the country. Reason? You still can't beat it on *performance*. The new low price of original, genuine PIVAL Concentrate makes it more popular than ever. Get it from your favorite Motomco Distributor.

PIVAL is tops in acceptability! Tests with other anti-coagulants show PIVAL has substantially greater acceptability, offering more effective control.

PIVAL resists insects! PIVAL baits are less subject to insect infestation even under severe conditions which means baits remain uncontaminated longer.

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Join the leading P.C.O.'s who pick PIVAL for dry baiting. Now time-tested, it's been proven tops for controlling Norway rats, roof rats and house mice. Order now.

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mology laboratory of Gulf Research & Development Company showed the repellent emulsion looked promising, and a test was designed to study the repellency of the emulsion against German cockroaches. The emulsion concentrate was diluted as recommended to 1% R-11 and 3% MGK-264. A total of 12 ml. of the diluted emulsion was sprayed on the entire *inside*, including the flaps, of a returnable beer carton (18″ x 11½″ x 7″). The treated beer carton and an untreated one (both with flaps closed) were placed in a stainless steel ring, 32 inches in diameter and 3 inches high. This ring is used in the Gulf racetrack method of cockroach testing, and is coated with a light grease on the inside to keep the cockroaches from escaping. One day a week for 20 weeks, 50 large German cockroach nymphs were placed on the floor of the ring that contained the treated and untreated beer cartons. A count was made on that day at hourly intervals (6 to 8 counts per day) of the number of cockroaches in each carton. When the counts were being made, the flaps on the cartons were lifted slowly and carefully so as not to alarm the roaches unduly. At the end of the test day the cockroaches were discarded. The lights were on in the test room during the day the cockroaches were counted in order to make them seek shelter in the cartons.

Redesigned flap of carton (left) opens up fold-funnel where cockroaches hid in flap of carton of old design (right). Former style also definitely interfered with spraying for the control of roaches: New design discourages hiding by roaches and makes it easier to spray-treat cartons with insecticide.

The percentage of repellency was determined by the ratio of the number of cockroaches in the treated beer carton as compared to the number in the untreated beer carton. For example, if after 6 to 8 counts a total of 15 cockroaches was in a treated carton and 177 in the untreated carton on a given day, the repellency was 91.5%, e.g., 100 - 15/177 x 100= 91.5%. While the test was under way, the cartons usually contained 50 to 70% of the total test cockroaches, some of the cockroaches remaining outside in the ring. For the first 5 weeks after spraying of the carton, over 90% repellency was shown by the treated carton. The average per cent repellency on a monthly basis for 5 months is shown below:

Month	Per Cent Repellency of Treated Case Compared to Untreated Case
1	93.8
2	82.0
3	70.5
4	65.2
5	64.2

On the basis of the above results, we recommended that the brewery try the repellent emulsion to determine how it would work under practical conditions. Following our recommendations, the spray apparatus was changed from one nozzle to four adjustable nozzles so that the entire inside of the

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problems
Total service—from chemicals to application equipment. Your Larvacide distributor has full technical facilities and know-how to help on all details . . . including automatic Larvacide systems.
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Publications *to write for...*

Here are the latest government, university and association publications of interest to pest control operators. Some can be obtained free of charge, while others are nominally priced. When ordering, include title and catalog number, if any. Sources follow booklet titles.

Controlling Insects and Diseases on Ornamental Trees. Catalog No. E269. Michigan State University, Dept. of Information Services. Bulletin Office, 10 Ag Hall, P.O. Box 231, East Lansing, Mich.

Weeding Forest Stands. Publication No. 372. Mailing Room. University of Massachusetts, Amherst, Mass.

Chemical Control of Woody Plants. Publication No. 323. Mailing Room, University of Massachusetts, Amherst, Mass.

Rotomists Shade Tree Sprayers. Catalog. John Bean Division, Food Machinery & Chemical Corp., Lansing 4, Michigan.

Highway Right-of-Way and Brush Control Sprayers. Catalog. 8p. il. John Bean Division, Food Machinery & Chemical Corp., Lansing 4, Michigan.

Radio Frequency Electric Fields for Stored Grain Insect Control. Paper No. 962. Stored Grain Insects Laboratory, Kansas State University, Manhattan, Kansas.

Test Methods for Establishing Levels of Susceptibility and Detecting the Development of Resistance in Insects of Public Health Importance. Reprint No. 313. 7p. October, 1960. Communicable Disease Center, Technical Development Laboratories, P.O. Box 769, Savannah, Ga.

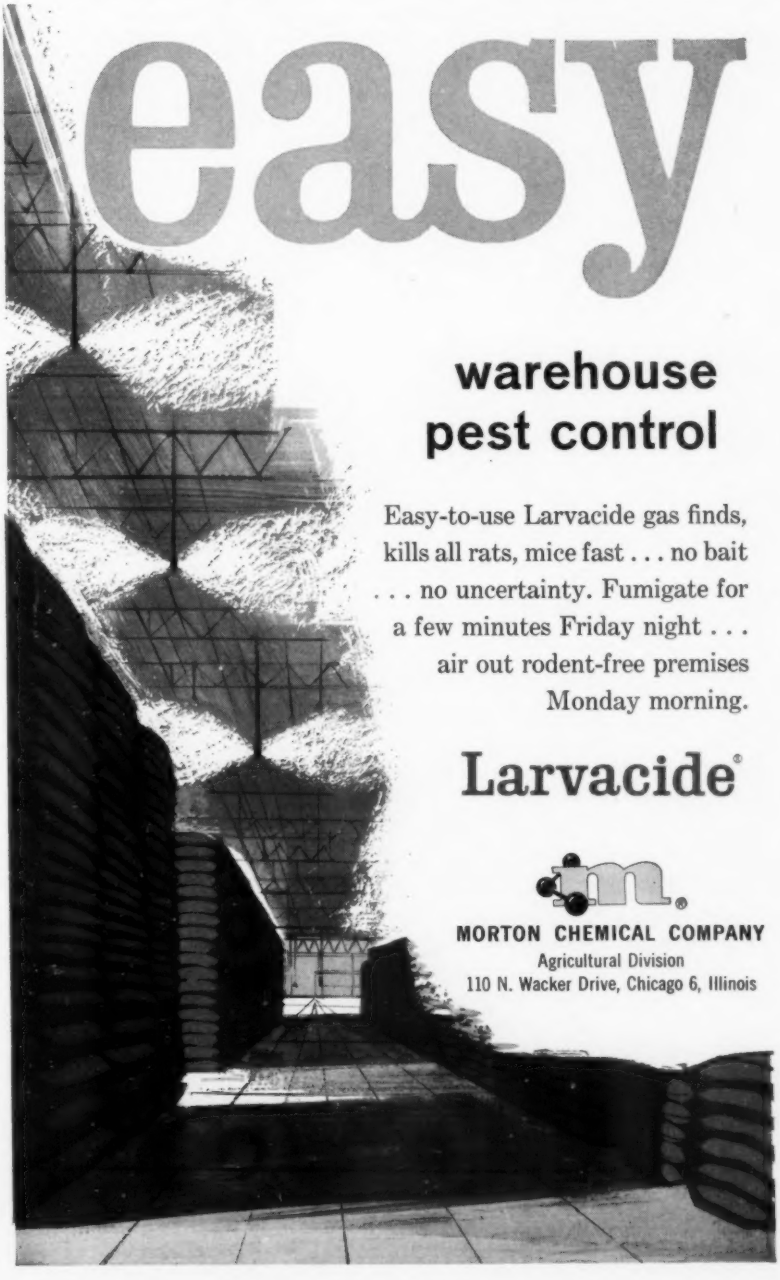
Biochemical Aspects of Insect Resistance to the Chlorinated Hydrocarbon Insecticides. Reprint No. 314. 19 p. October, 1960. Communicable Disease Center, Technical Development Laboratories, P.O. Box 769, Savannah, Ga.

carton and the inner surfaces of the flaps were sprayed in one operation.

Treatment of Trucks

In regard to the treatment of the trucks filled with returning cartons, tests were conducted with a pyrethrins-synergist solution dispersed by a small compact fogging unit. Cages containing German cockroaches were placed in the empty cartons. The inside of the truck was then fogged thoroughly, and the doors at the back end of the truck were then closed for 15 minutes. An examination of the test cages of cockroaches on removal of the beer cartons from the truck showed the fog to be ineffective in controlling the cockroaches inside the beer cartons because of lack of penetration. Because of this, it was recommended that the cartons be removed from the truck, and that the inside of the truck be sprayed with a high concentrate pyrethrins-synergist oil base spray using an electric sprayer to control the cockroaches in crevices in the truck. It was also recommended that loading platforms be frequently sprayed with the same spray to kill any cockroaches hiding in crevices in the platforms.

The brewery in question followed these recommendations during the 1960 season, including the use of the repellent formulations and the pyrethrins-synergist sprays as contact insecticides in trucks and around loading platforms. The cost of treating each beer carton with the repellent emulsion was reported to be 0.6 cents per carton. These measures, combined with the regular services of a PCO, were successful in solving the problem of German cockroaches being shipped from the brewery in beer cartons.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Easy-to-use Larvacide gas finds, kills all rats, mice fast . . . no bait . . . no uncertainty. Fumigate for a few minutes Friday night . . . air out rodent-free premises Monday morning.
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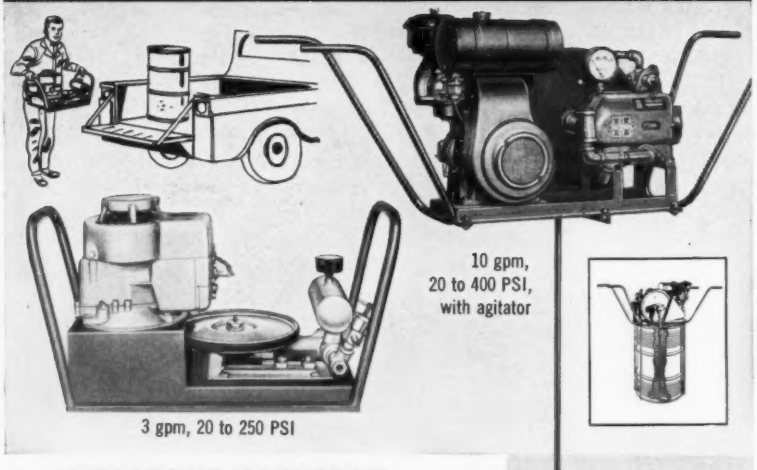


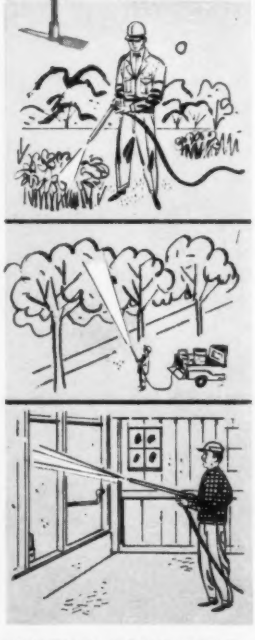
COMPACT, FLEXIBLE... IDEAL FOR MANY JOBS!

Here is one of the handiest profit-building tools to ever come your way: A positive piston high pressure spray pump coupled to an engine that makes a compact and portable power sprayer . . . takes up as little as 2 square feet of space, weighs as little as 68 pounds.

What can you do with a unit like this? Put it on your pickup truck with two or three 55-gallon drums. Drive to your location, start the engine, and you are ready to spray—at high or low pressure, from 20 to 400 pounds. Use wettable powders, oil emulsion, whitewash—this positive piston pump will handle any sprayable material. Switch spray materials by simply moving the spray-unit from one drum to another.

Where can you use them? For custom residential work, parks, recreation grounds, around factories—on the farm for whitewashing barns, spraying grain bins. You name it, Porta-Power Spray-Pumps will do it.

Five models, 3, 5 or 10 gpm, 20 to 250 or 400 pounds pressure, with or without mechanical agitator.



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New Ways to Control Insects

(*from page 19*)

chromosome of a strong race will preponderate over the female determinant of a weak race and lead to the development of an intersex form. Continued release of strong-race males should in time depress the population. A risk exists, however, in that the males of the introduced race would transmit new characters that might aid in perpetuating the species.

Another approach might be the rearing of strains having an excess of males. Craig, Hickey, and VandeHey (1960) reported that crosses between certain strains of the yellow fever mosquito (*Aedes aegypti* (L.)) produced a high percentage of males. The production for release purposes of males to be sterilized either by irradiation or by chemicals would be facilitated by such a strain. If the character of high male productivity can be passed from one generation to another, at least the first generation resulting from crosses with normal females should show a reduction of females within the wild population. If the character be dominant, this reduction could be great, especially if the abnormal strain were released repeatedly in numbers exceeding the normal population. However, a much longer time would probably be required to achieve eradication by the dominant-male approach than by the introduction of sterile males in the natural population.

Use of Inferior Genetic Strains

Useful characters of different types have been bred into plant and animal species. Strains greatly improved as to yield, quality, and resistance to environment or diseases have been developed. Knipling (1960) proposed that inferior insect strains could probably be produced in the laboratory and introduced on a systematic and continuous basis into a natural population. The inferior strain might easily be reared under controlled conditions and when released in the adult stage into the natural population it might survive long enough to add its inferior genetic characters to that population. Some of the useful genetic deficiencies might include inability to diapause, inability to fly but re-

BULLETIN:

Massive Shell newspaper promotion makes termite control nationwide news. Read how to tie into this promotion to increase your business.

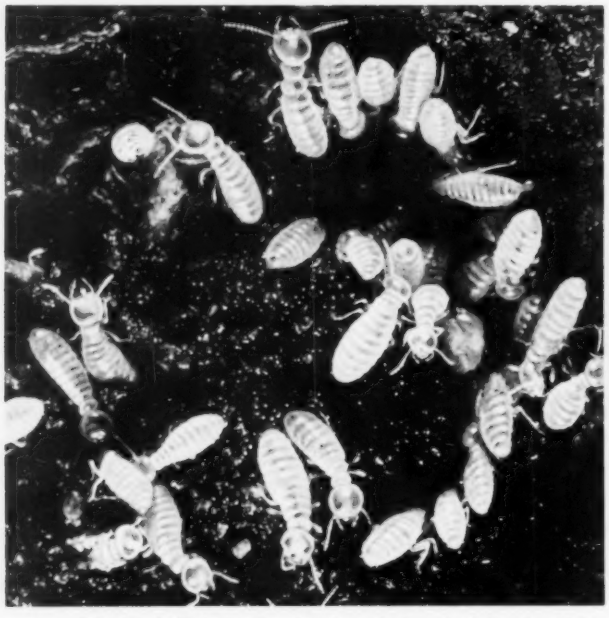


Photo courtesy of United States Department of Agriculture

Left: worker termites. They invade your home and cause damage such as shown on the right. The workers and the damage they cause are almost never seen unless siding or inside walls are removed. Read how Shell's dieldrin can save your house.

HOMEWRECKERS:

Millions of termites may be eating your house without your knowing it. Shell discloses five danger signs to look for. And tells how a powerful Shell insecticide wipes out termites—protects against further invasion for years.

Termites are found in every state except Alaska. In every type of neighborhood. Each year, they cause over $100,000,000 worth of damage.

This is the swarming season for termites. It is the best time to spot them.

Shell tells how to detect these tiny homewreckers. And how your local exterminator uses powerful dieldrin insecticide, developed by Shell Research, not only to wipe out termites already in your house, but to form a protective barrier around it that termites cannot penetrate for at least ten years.

TERMITES attack homes everywhere—in cities, suburbs and rural areas. In every kind of neighborhood. They have no respect for property values.

Subterranean termites not only feed on the wood in houses but devour books, rugs, linoleum, furniture and fabrics.

Know the enemy

To understand how Shell's dieldrin stops invading termites, you must know a few things about the fascinating way they live.

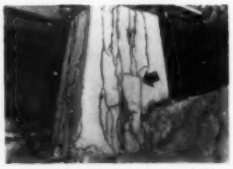
Termites live in colonies in the soil. Each colony can contain as many as 100,000 termites. And there can be *hundreds* of colonies in the area around your house.

The termite's food is wood. Unfortunately, the nearest source is often your house.

How termites invade your house

Termites construct tunnels through the soil to your house—directly to wood if it is touching the ground. If not, they tunnel through cracks and crevices in brick and block walls and up to wood through voids.

Where there is no other way, they build earthen tunnels up the side of the foundation.



Danger sign. Termites use earth to build vine like tubes (arrow) up walls and pillars to the wood in your house.

Once inside your house, they travel great distances by simply eating tunnels through the wood. And through many items in contact with it. Some examples: stored food, home insulation, wallpaper—even leather shoes.

Dieldrin sets up a road block between the soil and your house

Here is how dieldrin works. When dieldrin is applied to the soil around and under your house, it sets up a chemical barrier that termites cannot penetrate without being killed.

But what about the termites that may already be *in* your house? Few people realize that termites regularly *return to the soil* from the house, to get water. Dieldrin turns your house into a termite trap. If the termites venture into the soil, dieldrin kills them. If they stay in the house, they die of thirst.

One application lasts for years

Shell's dieldrin is powerful stuff. It only takes two gallons of 18% dieldrin concentrate to protect an average-size house.

But most important, dieldrin lasts in the soil. Not for a few days, or weeks, or even months—dieldrin lasts for years.

In tests conducted by the U. S. Forest Service, dieldrin has remained 100 per cent effective in the soil for 10 years. And there is every reason to believe this protection will actually last far longer than that.

Don't confuse termites with flying ants. Note the difference. Termites are narrow-headed with two sets of brittle, white wings of equal size. Ant bodies have three segments. Wings are transparent and unequal.

Danger signs to look for

Termites are very secretive about their work. There are, however, five danger signs you can look for.

1. Now through June, watch for flying and crawling swarms of termites inside and outside your house. (See drawing below.)

2. Look for numerous detached, white wings on the ground around your house. King and queen termites shed them before entering the ground to start a new colony.

3. Look for greyish, earthen-like tubes or tunnels on cellar walls, in crawl spaces and on supporting pillars. These tubes look like vines and are commonly found near cracks and separations. They will invariably lead to wood.

4. Termites commonly attack sills, beams, and outside porch supports. Probe these areas with a screwdriver. Softness or hollowness may indicate the presence of termites.

5. Floors sagging under heavy furniture, weak stairways, or a sudden settling of the house are more advanced symptoms. While they may not be caused by termites, they should be checked immediately.

Exterminators guarantee dieldrin

If you suspect termites, call an exterminator.

Most exterminators will inspect your home without charge. They are experts, and can tell you whether you have termites or not. If you do, they can recommend the most efficient and economical dieldrin program for your particular problem.

Exterminators who use dieldrin will guarantee their work for years.

Dieldrin can protect your lawn too

Dieldrin has many other uses. Farmers have relied on it for years to protect hundreds of crops from destructive soil and foliage pests.

Nurserymen use dieldrin to protect ornamentals, shrubs, trees and flowering plants.

You can use it to protect your lawn against soil insects; your flowers against foliage insects; and your home from household insects such as flies, mosquitoes, roaches, silverfish, wasps, carpet beetles, spiders and ticks.

Look for insecticides that contain dieldrin at your garden supply or hardware store. They are sold under many well-known brand names.

If you would like more information on termite control, write: Dieldrin, Shell Chemical Company, 50 West 50th St., N. Y., N. Y.

1,997 Shell scientists at work

Dieldrin is a good example of the creativity of Shell Research. No fewer than 1,997 scientists are busy developing new products in dozens of fields. And improving familiar ones, like Super Shell gasoline.

Today's Super Shell contains nine different ingredients. Shell scientists insist on it—so they can promise you *top performance* for your car.

SHELL®

Shell Chemical Company

Avalanche of inquiries. Dr. M. J. Sloan, Shell Chemical Sales Development Manager, goes through some of the thousands of inquiries Shell received during the week of May 8th. Almost every letter represents business for a PCO.

Shell's nationwide dieldrin promotion uncovers millions of dollars' worth of termite business for PCO's. Here is how Shell is helping you get your share of this new business.

During the week of May 8th, Shell Chemical's "Homewreckers" ad (left) ran in 178 major newspapers. It told 32,000,000 people how to detect termites and how their local pest control operator can use dieldrin to wipe out termites and to form a barrier that will protect their houses for years.

Early response to the ad shows that thousands of homeowners are concerned about termites. Read about this response and how you can capitalize on Shell's promotion to get more termite control jobs.

Most homeowners like to think termites are somebody else's problem—not theirs. "Homewreckers" was designed to give 32,000,000 Americans a jolt. It did.

In the first few days after "Homewreckers" had run, Shell Chemical received over 19,500 inquiries. *They are still pouring in.* Almost without exception, each of these inquiries represents business for PCO's. Hundreds of PCO's have written to tell us that they have already started jobs as a result of this ad. That was its purpose.

Shell stresses local PCO's

Shell's "Homewreckers" ad establishes that termites are a national problem. It gives homeowners five danger signs to look for to detect termites. It shows them the difference between termites and flying ants. And it tells them the only sure way to clear up a termite problem is to have *dieldrin* applied by an *expert*—their local pest control operator.

How you can capitalize on this free publicity

Shell's nationwide "Homewreckers" promotion has informed millions of homeowners about the dangers of termites. They need and want help.

Shell has prepared local promotion material so that you can get *your* message to some of the millions of people that saw the ad—and incidentally to people who did not.

The next page tells you how to take advantage of this opportunity to increase your business.

FREE:
Mail this card for free promotional material from Shell.
See next page for details.

Postage Will be Paid by Addressee

No Postage Stamp Necessary if Mailed in the United States

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NEW YORK 20, N.Y.

ATT: ADVERTISING DEPT.

This full-page advertisement ran in 178 major daily newspapers with a combined circulation of more than 32,000,000. It told homeowners in your area to call *you* for help.

Here is how you can get more termite control jobs with these free "Homewreckers" selling aids

Shell has prepared window banners, mailing pieces and advertising mats to help you tie in with its "Homewrecker" campaign. Each is available, free of charge, and in any quantities you desire. Simply fill out the postcard below, and mail it today.

Window display—Full-size, 14¾" x 22" reprints of Shell's "Homewreckers" ad are available. They can be displayed in your window, on your trucks—any place that receives public attention. The window displays are printed on special heavy-duty paper that will not curl, yellow or fade.

Stuffers and leaflets—Handy 11" x 18" "Homewreckers" reprints are available. They can be handed out or used as mailing stuffers. Leaflets are also available. They explain how dieldrin works. NOTE: There is space on the stuffer and the leaflet for your name, address and special sales message.

Newspaper mats—Shell has prepared newspaper mats that let you tie in with the "Homewreckers" campaign. They describe the five danger signs to look for and stress the necessity for your professional services for effective termite control. There is space in each mat for your imprint.

Please send me the items checked below:

☐ **Window displays**_____ (quantity)

☐ **Leaflets**_____ (quantity)

☐ **Stuffers**_____ (quantity)

☐ **Newspaper mats**_____ (quantity)

Name_____
PLEASE PRINT

Name of Company_____

Street_____

City_____ **Zone**____ **State**_____

How to learn more

For technical information about dieldrin and for a source of supply in your area, contact the Shell Chemical District Office nearest you.

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MU 6-9580

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New Orleans 12, La.
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tention of ability to walk or crawl, and certain deficiencies in immature stages such as deformed mouth parts. As far as is known, very little research has been done on the development of deficient insect strains that could be so used. The selection and development of such a laboratory strain might prove to be easier than the production of one with so-called superior characteristics such as insecticide resistance.

The Use of Attractants

Attractants for control of insects are not new, but they merit much more attention than has been assigned to them. The finding of powerful attractants for the various species of insects is not easy. However, excellent progress has been made for some insects.

In various parts of the world research to find strong attractants for use in tropical fruit fly detection or control programs has been in progress for more than 50 years. Several materials or mixtures have been developed, some of which have been useful. The spectacular accomplishments with methyl eugenol (Steiner and Lee 1955) as an attractant for males of the oriental fruit fly coupled with fruit fly emergencies in California and Florida have stimulated renewed interest. Research has been conducted by Division entomologists (Porter and Christenson 1960) and Division chemists (Beroza 1960) to explore and synthesize new and related compounds for use against various species of fruit flies.

In an intensive screening program at the Division's laboratory in Hawaii, angelica seed oil was found to be a powerful attractant to the Mediterranean fruit fly (Steiner *et al.* 1957). In a special synthesis program others were soon developed. One of these was siglure (*sec*-butyl 6-methyl-3-cyclohexene-1-carboxylate) (Gertler *et al.* 1958). After a shortage developed in the world supply of angelica seed oil, siglure was used extensively for detection of the Mediterranean fruit fly in the 1956-57 eradication program in Florida. Siglure is easily made and comparatively low in cost. An even more effective male medfly attractant, trimedlure (4(or 5)-chloro-2-methyl-*tert*-butyl cyclohexanecarboxylate) has been synthesized recently (Beroza *et al.* 1959). This lure is now replacing the others in detection programs.

Another excellent and powerful lure is the sex attractant of the gypsy moth. For many years extracts of the tip of the abdomen of the female gypsy moth have been used in traps to determine the incidence and distribution of this pest. Males came in large numbers from long distances. Jacobson (1960), a Division chemist, announced the chemical identity of this attractant and synthesized the compound in the laboratory. This material, known as gyplure, is easily made and low in cost. Studies are now under way to determine if male gypsy moths can be attracted and destroyed in sufficient numbers to reduce infestations.

These examples of attractants have so far not been of any direct benefit to the control of mosquitoes, flies, cockroaches, and ticks. Much work needs to be done on the sex behavior of these various insects. Can we find if flies, for example, produce a chemical attractant? Preliminary work on the extraction of flies or parts of flies to find if an attractant actually exists has not been promising so far. However, it may be that flies are not captured at the right time to find the attractant, if indeed one does exist. Furthermore, the attractant may not be found by extraction for the reason that the attractive substance may be deposited on areas where the flies sit or walk. The powerful attractant produced by the European pine sawfly (*Neodiprion sertifer* (Geoff.)) cannot be found by extracting the attractive substance from the insect itself but can be recovered from surfaces where the sawfly rests or by external rinses of the females with appropriate solvents.

Attractants for getting the sexes together for mating may work indirectly, that is, the sexes may be brought together by being attracted to a common meeting area. Cattle may possibly be the stimulant to bring screw-worm flies together for mating. It seems almost inconceivable that the sexes find one another by chance only. Research is needed to determine the mating habits of most species of insects. The causative agents to be

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considered in insect attraction may not be chemical substances but sounds or other means of communication. The Entomology Research Division, in cooperation with the Agricultural Engineering Research Division and Animal Husbandry Research Division, is initiating a basic study on the control of flies around livestock buildings with electro-magnetic energy, supersonics, and other attraction or mechanical devices. It is hoped that this research will be fruitful in an elucidation of insect attractants.

Summary

In summary, we can state that the direction of our research on control of insects is beginning to change. Insect resistance and the possible hazards of the use of insecticides to man and wildlife are the major reasons for the development of new approaches.

Interfering with insect reproductive potential has considerable promise but imposes a thorough knowledge of basic biology.

The release of sterile males into a natural population is one promising approach. The screw-worm was successfully eradicated from the Southeast by this method.

Sterility induced by chemicals applied in the natural environment of insects is a theoretically practical new approach.

The recent discovery of chemicals that will sterilize both males and females of house flies, mosquitoes, and stable flies by contact or ingestion provides exciting possibilities for control, but reduction of any given species will be slow. However, combined insecticide and chemosterilant treatments appear to be feasible. The insecticide will act quickly on the weaker individuals of a population and the chemosterilant should make the stronger individuals sterile. Community action will no doubt be necessary to achieve best results.

The rearing and release of hybrid insects may have possibilities in the control of certain species. The development of inferior genetic strains with their consistent release in great numbers has good potential for control.

Attractants for drawing insects to a place where they can be chemically treated or mechanically destroyed also show promise.

A staggering amount of research faces entomologists, chemists, and others in the development of these new approaches to the control of any given species. We must not only determine the habits of insects more completely than ever before but also devise ways to use and test the new ideas and techniques, individually and in combination.

Pest control operators will recognize that considerable study and work have been expended on new approaches. They can feel assured that entomologists are looking toward the future as well as currently investigating every possible substitute insecticide. It is our belief that during the next few years research will provide us with dramatic new ideas and procedures to control insects. Eradication of certain species may well become a reality.

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Major powder post beetle infestations require a house to be completely covered with tarpaulins and fumigated as shown in this picture of a California home under treatment.

A New Method for Control of Powder Post Beetles

By **NORMAN R. EHMANN**

Neil A. Maclean Company, El Monte, California

The most common species of powder post beetle which the termite control operator in Southern California encounters are Lyctus brunneus and Lyctus planicollis. He finds these beetles raising havoc in hardwood floors of family dwellings, hardwood wainscoatings, and in warehouses where hardwood items such as shovel and axe handles are stored.

Adult powder post beetles lay their eggs in the pores of wood as well as in old emergence holes. As larvae hatch they bore down into the wood and, following the grain of the wood, reduce it to a fine facepowder-like frass. Except for the "exit hole," all the damage to the hardwood is accomplished by this larval stage. Larvae pupate, usually near the surface of the wood, and the resulting adult beetle then bores its way through the surface to the outside, pushing out the characteristic mound of fine facepowder like frass. These exit holes and mounds of frass are frequently the first clue the homeowner has of the powder post beetle infestation.

Termite operators in Southern California have found two very efficient methods of dealing with powder post beetle infestation in houses.

If a thorough inspection reveals an extensive infestation throughout the hardwood floors of the house, a methyl bromide fumigation is indicated. Then the entire house is covered with vinyl coated nylon tarps and methyl bromide is injected at a dosage of 2 lbs. of methyl bromide per 1,000 cubic foot of space under the tarp. The gas is held for 24 hours. If tarps are properly sealed around the base of the house, and if readings on the Fumiscope indicate the presence of 5 ounces or more of methyl bromide at the end of the 24 hour period, it can be fairly safely assumed that a good kill of beetle adults, pupae, larvae and eggs was obtained. As a conservative measure some operators routinely increase the dosage to 3 lbs. of methyl bromide per 1,000 cubic foot of space under the tarps and leave the tarps on the house for 48 hours. This increased dosage and exposure time is an added precautionary meas-

Mop, pail, tarp, and chemical are all that's necessary for control of localized powder post beetle infestation according to method described in this article. Above, floor is covered with taped-down polyethylene sheeting over area that has been mopped with S.T.D.

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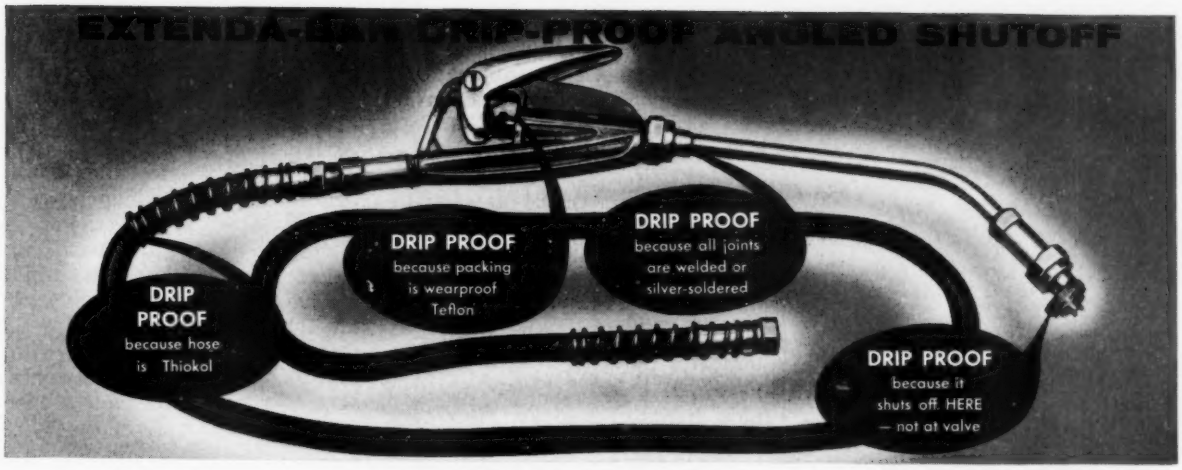

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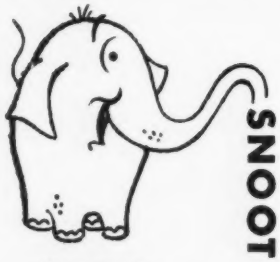

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ure against re-do's and tends to give the TO an added sense of security. However, many successful jobs have been performed at 2 lbs. per 1,000 feet for 24 hours. The important factor is the amount of methyl bromide left in the structure at the 24 hour mark. Increased dosage doesn't mean a thing if the methyl bromide is not held within the structure involved.

If on the other hand, a thorough inspection of the structure indicates the possibility of a very localized infestation of powder post beetle in a few flooring boards in one or two rooms, an entirely different control measure is adopted. The tools needed for this job are: A mop, a bucket, an ethylene dibromide preparation known as S.T.D., a piece of polyethylene tarp and some paper masking tape.

An infestation on the floor of a given room is carefully marked out by the TO. The polyethylene sheeting is cut to size to cover the area to be treated. S.T.D. is then poured into a bucket or shallow pan and mop is soaked with S.T.D. by dipping it into the pan. Surface of the floor previously delineated is then mopped with S.T.D. Care is taken not to puddle the fumigant but merely to wet the surface as one would spreading wax with a mop. Next put the tarp in place. Edges of the tarp are then taped down to the dry floor surrounding the treated area. Windows in the room are left open and occupants of the house are prohibited from occupying the room for the next 24 hours.

At the end of the 24 hour period the polyethylene tarp is removed. In most cases varnish on the floor is not harmed but the wax has been dissolved. The termite operator need merely re-wax the floor and his job is completed. If the varnish is affected, then a

Meet Drs. Lund . . .

You're not seeing double; each is Dr. Lund. Recently at Purdue University Dr. Horace Lund (left), head of the Department of Entomology at the University of Georgia in Athens, met for the first time Dr. Anders Lund (right), scientist at Koppers Research Laboratories in Verona, Pa. Both men are currently involved in different phases of nutritional studies of termites. Each has written for *Pest Control* and is actively cooperating with the pest control industry.

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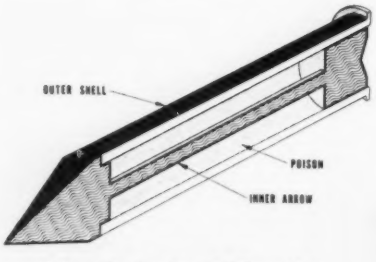
Severely infested floor board showing powder post beetle exit holes.

resanding, revarnishing, and rewaxing job must be done.

Many, many localized infestations of powder post beetle have been successfully controlled by this method in Southern California at a fraction of the cost of a complete house fumigation and with no harmful effects to occupants of the house.

Claims "Nail" Will Control Termites

A nail-like cartridge said to contain calcium arsenate, is featured in a device called X-Termi-Nail that is claimed to be "a new method of termite control." Mariae Associates, Box 664, Glendora, Calif., its distributor, says the device is primarily designed for new buildings, but "can be used on older houses, utility poles, farm wooden fences, or any other construction subject to termite infestation."



Schematic drawing of X-Termi-Nail.

Descriptive literature says an ordinary building hammer can be used to drive the X-Termi-Nail flush and tight against the surface. Then a 16-penny nail is driven through the head of the X-T-N to release the poison at the tip end.

Bulletin No. 156 is available free from the company and gives more details on the gadget.

Warranties and Taxes

The Tax Court has refused to allow a termite control firm to exclude as prepaid income his estimated costs of reinspecting work he had warranted for 5 years. The warranties permitted him to reinspect at indefinite times and make good if termites returned. Reason given by the court for disallowing this deferred deduction was that no adequate records were kept, there was no valid allocation of costs, and no proof the TO would ever be called back to do definitely measurable work because of his warranty.

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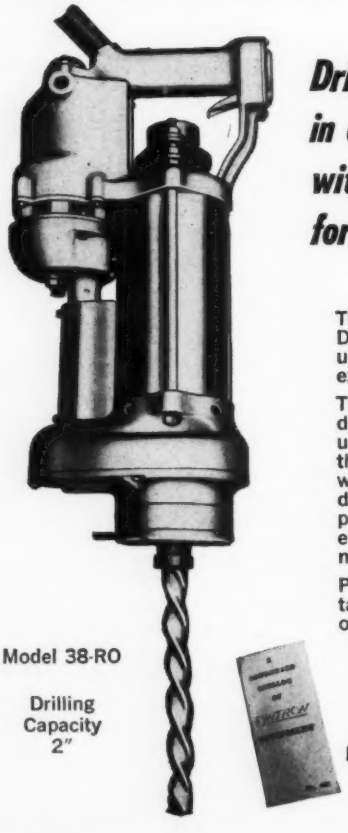

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Drilling Capacity 2"

Drill fast, clean holes in concrete or masonry with the 38-RO, designed for Pest Control men

The Syntron 38-RO Electric Hammer Drill is a heavy duty, 2" capacity unit, that is becoming the choice of exterminators everywhere.

The electromagnetic drive unit produces 3600 powerful blows per minute — drills clean holes quickly through concrete, stone, or masonry without manual quarter turning of drill bit—rotation is automatic. Simplicity of design assures life-long efficiency, dependability, and low maintenance.

Phone the nearest Syntron Representative for a free demonstration without obligation or . . . .

Write for a Syntron Catalog section on Electric Hammers & Hammer Drills.

61EH6

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790 Lexington Avenue • Homer City, Pa.

Letter About Tick Control

(*from page 6*)

they are proven effective and safe for such use.

The chemicals being widely used by vets today are: delnav (0.12%); malathion (1%) and lindane (.03%) combination; diazinon (.25%); and some rotenone. These chemicals are used for dipping which is by far the best method of application. None of these chemicals is recommended for cats.

Malathion (2 to 5%) and sevin (3 to 5%) are the most popular as dusts for use on both cats and dogs. However, malathion is not so good for tick control especially against engorged ticks. Sevin is extremely good against all forms of ticks.

In my opinion delnav as a dip and sevin as a dust are the best chemicals being used by veterinarians today.

Delnav and diazinon are not permitted as yet for use on small animals by the lay trade. The most commonly used chemicals as dips to the lay trade are: malathion (.5%) lindane (.015%) combination, and rotenone. Many chemicals are permitted in dusts including the above two plus sevin and pyrethrins. The malathion (.5%) / lindane (.015%) combination is best for ticks (lindane added for the engorged tick) as a dip, and sevin (3 to 5%) is best as a dust.

Mr. Gerhardt mentioned in his article that toxaphene was recommended, but since it is toxic to small animals it must be used with care.

Toxaphene is *never* recommended for use on small animals, both cats and dogs, even under the most controlled conditions. No company has had more experience on the use of toxaphene for parasite control on both large and small animals than my own. If toxaphene had been tested on dogs only in the early days it would never have been permitted for use and would not be the most widely used chemical for tick control in the world today.

The treatment of premises for control of fleas and ticks is somewhat out of my line and I have had but little experience.

Treatment of yards, homes, and kennels must be done with care since accidental poisonings could result due to either youngsters or pets handling or playing with objects freshly sprayed, etc. If this is not a problem, then toxaphene (.5%), delnav (.5%), diazinon (.5%), or dieldrin (.25%) would give excellent control of both ticks and fleas. Malathion (.5 to 1%) would be excellent for fleas alone.

Sevin (5%) powder placed in areas where ticks hide in kennels or the home, such as cracks, baseboards, around pet's bedding, etc., is excellent for crawling ticks.

I would also like to point out an apparent typographical error on page 47 of the March 1960 issue. Dr. Drummond is reported to have mentioned delnav as a .015% dip for dogs. The figure should be 0.15%, but this refers to the recommendations for large animals. Delnav is recommended by us to be used at 0.12% as a dip for dogs. Delnav at 0.05% is safe for use on cats for flea control, but is hardly effective for ticks. However, ticks on cats usually are not a problem.

You are doing an excellent job of editing and I enjoy reading the issues as they come out since that is about the only way I have of keeping informed of developments in the pest control industry.

W. V. Miller

Head, Research & Products Development
William Cooper & Nephews, Inc.
Chicago, Ill.

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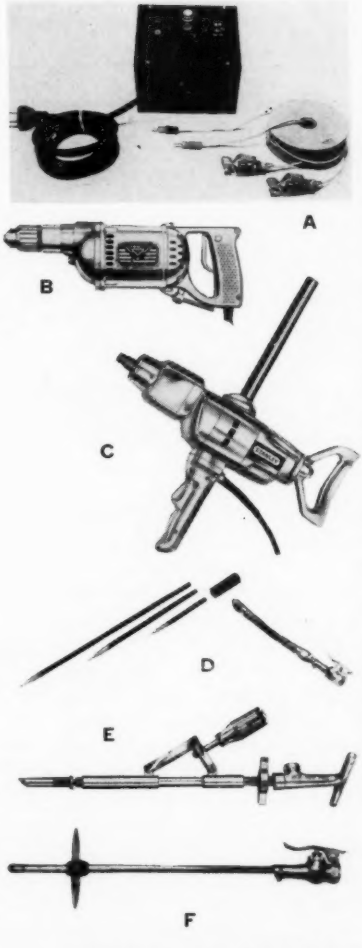

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D. ROD NOZZLES For soil injections, and for pressure treating of wood, concrete block and slabs, use these improved, long-lasting tools. Forged steel tip on *seamless* iron pipe.

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What's NEWS In The Industry

Yoemans Tells CSMA Chicago Meeting of New Pesticide Application Methods

A breakoff nozzle used on one-shot aerosol dispensers as well as encapsulated vapor toxic insecticides in ampules are two new pesticide application techniques described by Dr. A. H. Yoemans to the Chemical Specialties Manufacturers Association 47th Mid-Year meeting in Chicago's Drake Hotel, May 14-17. Nearly 1,000 came for the convention which holds five simultaneous divisional meetings covering automotive chemical specialties, disinfectants and sanitizers, waxes, polishes, and floor finishes, aerosols, and insecticides.

Yoemans was reporting on work run in conjunction with Dr. R. A. Fulton, both of whom are with the U. S. Department of Agriculture, entomology research division.

The one-shot, breakoff nozzle enables inexperienced personnel to easily release the entire, measured contents of an aerosol container. The nozzle itself has no function in atomizing the spray, but is connected with a capillary siphon tube with a ratio of inside diameter to length which will produce boiling and thus atomize the contents into particles within the aerosol range. This technique appears to be particularly useful in pesticiding airplanes, warehouses, and food processing plants.

Vapors from organophosphorus insecticides are dispensed in the other new development utilizing an insecticide-filled ampule imbedded in a thick cheesecloth bag. When ready for use, the ampule is broken and the solution saturates the cheesecloth from which it evaporates. For fast action the ampule can be broken and placed in the bag of a tank-type vacuum cleaner. After about 15 minutes of operating the cleaner, the solution is evaporated from the cheesecloth and the vapor is well distributed in the room. "The room should be left closed for a half-hour or more. For overnight treatment the ampule can be broken and placed in a pan so that the solution can slowly evaporate. A 20% solution of DDVP in xylene at a dosage of 2 grams of DDVP per 1000 cu. ft. has been used with success against flies, German cockroaches, and several other insects," Dr. Yeomans reported.

Grades of Pressurized Sprays Important to User

Differences between aerosol and pressurized space sprays emphasize the need for careful purchasing of such gassed insecticides. John Odeneal, of Fairfield Chemicals, brought CSMA listeners up to date on these products by explaining that aerosol space sprays have finely divided particles 80% or more of which have a mean diameter of 30 microns or less. No particle in such a spray has a diameter of more than 50 microns. Pressurized sprays deliver a mist with particles above 50 microns and a mass mean diameter of 25 microns.

Pressurized sprays are being packaged in A and B grades which mean one requires less to be used than the other.

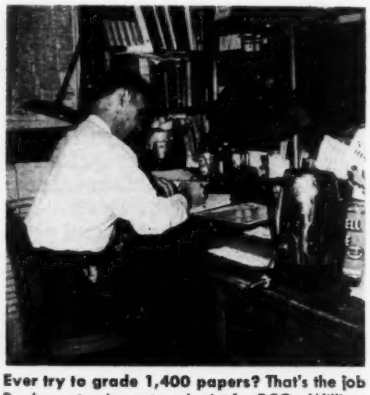
An A Grade pressurized spray or aerosol equals or exceeds the CSMA Official Test Aerosol when compared to 3 grams plus or minus 0.5 grams/1000 cubic feet. Grade B is reserved for pressurized sprays equalling the O.T.A. when tested at 6 grams plus or minus 0.5 grams/ 1,000 cu. ft.

To the consumer, a 16-ounce aerosol container looks and operates the same way, whether it contains an aerosol or a pressurized spray formulation. "However," Odeneal advised, "the grade designation is even of more importance in pressure-dispensed products than with liquid sprays. As can be seen from the definition of a Grade B pressurized spray, twice as much material is required as for Grade A. Therefore a Grade B product, in a container actually will treat only one-half as much space as a Grade A insecticide in the same size container."

Butonate at Higher Levels

Currently butonate is being tested on roaches and flies at dosages higher than those at which original work was done, Robert Sharp of Prentiss Drug & Chemical told the group. The new organic phosphate insecticide has recently received USDA registration for use in aerosols at 1.5% against flies and certain other insects.

Summarizing butonate's advantages, Sharp said it has "very low mammalian toxicity, is soluble in most organic solvents, is compatible with pyrethrum, pyrethrum synergists, and other fast-acting knockdown agents. It is effective against houseflies and roaches in



Ever try to grade 1,400 papers? That's the job Purdue extension entomologist for PCOs, William Hazeltine, has every month to check the answers submitted by participants in the *Pest Control* Purdue correspondence course you'll find in this magazine for 18 months. Note the trusty coffee pot is close by to keep him going when Bill has to stay down at the office until the wee small hours.

Shell's Newspaper Termite Ad Reaches 30 Million Readers

During the second week in May, Shell Chemical Company inserted into 175 daily newpapers, a full-page advertisement to promote termite control with dieldrin. "If you suspect termites, call an exterminator," the ad says.

James J. Lawler, Shell Chemical sales manager, reports the campaign ran in 27 states reaching over 30,000,000 newspaper readers.

Headlined "Homewreckers," the termite control sales-boosting ad featured two large photographs at the top, one showing worker termites, and the other a termite-ridden siding of a house. It tells readers how termites invade homes, how to distinguish between termites and ants, and gives the reader danger signs to look for.

KORLAN 24E INSECTICIDE won't stain . . . lasts longer!

Want the number one insecticide for use in restaurants, food and meat plants, supermarkets, or other problem areas? Korlan® 24E insecticide knocks out even the resistant strains of flies and roaches . . . won't stain painted or whitewashed surfaces . . . won't leave a lingering odor . . . and kills where it's been sprayed for as long as six weeks!

Less toxic than any organic phosphate with equal residual action, Korlan 24E will give you a safe, powerful insect kill in *both* oil and water mixtures!

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Korlan 24E kills on all surfaces—even stainless steel . . . and it won't react chemically to corrode this or any other surface. Call your nearest Dow sales office for full information.

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oil solutions, emulsions, and powders, is non-staining, and has little objectionable odor."

Face Fly Controls Questionable

"The face fly cannot be wholly or even practically controlled by any of the common practices currently recommended for the control of flies on cattle." So said Dr. George C. Decker, principal scientist and head of the section on economic entomology at the Illinois Natural History Survey, Urbana.

In the short span of two or three years, the face fly, *Musca autumnalis* DeGeer, has risen from obscurity to one of the most dreaded pests of livestock, particularly cattle, and a first class household pest as well, Dr Decker explained.

"Livestock sprays or dusts containing residual toxicants such as DDT, chlordane, toxaphene, malathion, ronnel, or Co-Ral gave only temporary relief at best and were soon abandoned by all investigators," he reported about control efforts.

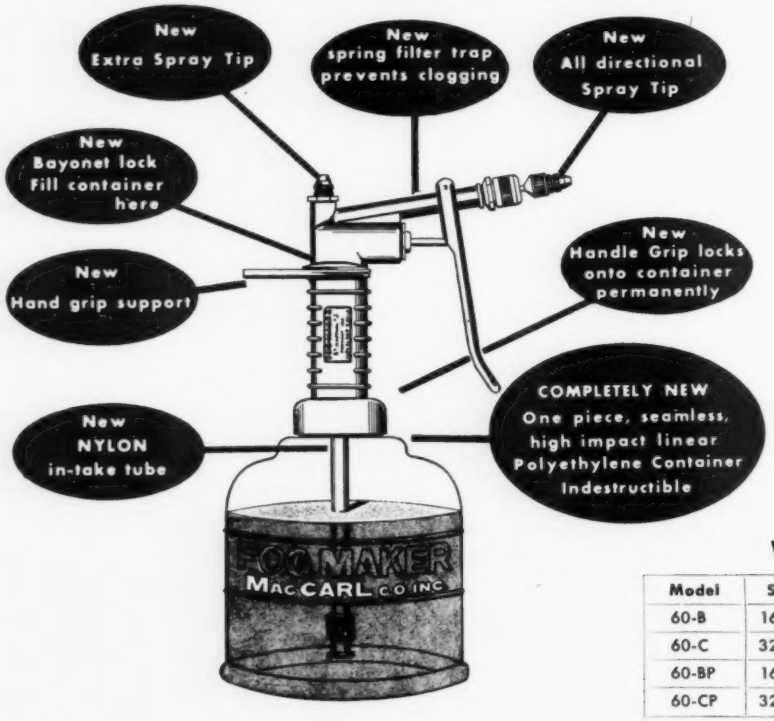
Since face fly breeding is confined almost exclusively to freshly dropped cow manure, sanitation is of little or no practical value in controlling the face fly. Results of toxicants and some repellents applied by "backrubbers" have been variable. When repellents are used as a basic treatment, applications practically need to be made daily which most beef producers regard as utterly impractical.

In Illinois, Dr. Decker explained, some success has been achieved by using baits applied to animals. The simplest and most effective bait contained 75% corn syrup, 25% water, and 0.1% DDVP. Fly acceptance of the bait seemed to be materially influenced by both the kind and amount of toxicant as well as by other components of the formulation. Baits containing the water-soluble DDVP and Dimethoate proved much more attractive than those containing the insoluble poisons such as diazinon, and baits containing 0.1% DDVP were more attractive than baits with higher concentrations of the same chemical.

Control of face flies seeking hibernation in the fall on buildings or as they filter from hibernation in walls, attics, etc. into living quarters during the winter and spring months presents problems comparable to those posed by the cluster fly and the boxelder bug under very similar conditions. "It's not a matter of lacking effective toxicants, but rather that a prolonged and persistent infiltration process introduces an element of futility. Techniques will depend upon the conditions existing at the time," Dr. Decker reported.

Other, natural factors are at work to keep this pest in check. It is well known that amphibians consume many insects that inhabit meadows, especially wet land areas. Spiders entrap many flies as well as other insects in their webs. Many birds and a number of mammals include insects in their diets, and there is evidence of fungus diseases that at times destroy literally millions of several species of muscoid and other common flies. Meteorological conditions also play an important role.

Next meeting of the CSMA will be its 48th annual conclave, held at The Roosevelt Hotel in New York City, December 4-6.



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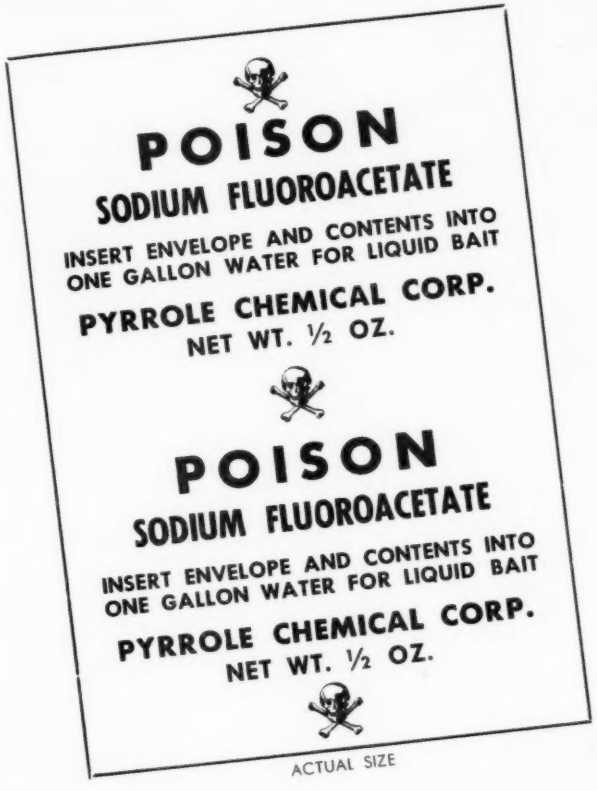
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Number of Resistant Insects Up 600% in 6 Years Canadian PCO Conference Is Told

"In 1955, 25 species of insects had developed resistance to insecticides. Now, only 6 years later, the total of species showing resistance is 139." So said Dr. A. W. A. Brown, of the University of Western Ontario, before the Canadian Pest Control Operators Conference held in Ottawa late in April. "When I first spoke to you at Guelph, in 1952," Dr. Brown explained, "it appeared hopeful that no resistance would develop to malathion and parathion. Now 29 species of insects and mites have developed resistance to organophosphorous insecticides."

Dr. Brown, who recently spent two years with the World Health Organization in Geneva, Switzerland, told the better than 60 delegates to this two-day meeting that the first proven resistance of German cockroaches to chlordane did not come until 1960 (see detailed report on page 62 this issue). Chlordane-resistant roaches, he continued, are also resistant to dieldrin and somewhat resistant to BHC; however their susceptibility to DDT remains unchanged. "DDT has been used with success against the German roach on American army bases in Europe," but it is not generally a good insecticide for this species.

"DDVP, the active ingredient in Dipterex, is an effective residual insecticide if admixed with an extender such as Aroclor 5460," the Canadian scientist reported in his discussion of ways to combat chlordane-resistant roaches.

Other outstanding speakers on the program included Dr. Lloyd Roadhouse, who spoke on new PCO insecticides and Dr. Ralph E. Heal, NPCA executive secretary, who gave a detailed discussion of industry safety and commended Canadian operators for their good safety record. Among featured specialists who talked to delegates were Dr. Robert Glen, director of the General Research Branch of the Canadian Department of Agriculture and his associates John B. Russel, C. G. Macnay, Miss I. Greelman, Dr. H. Hurtig, and Dr. Harold Gray, along with Professor R. H. Ozburn of Guelph Agricultural College, and W. L. Smith from the Ontario Department of Health.

At the Canadian PCO Association business meeting held during the annual conference, Arthur L. Wippman, of Windsor, was elected president. Chosen to serve with him are: vice-presidents W. O. Maheu of Montreal, W. C. Johnson of Waterloo, and Charles Riess of Winnipeg; secretary J. J. Parent, Windsor; treasurer C. S. Burton, Kingston; and directors Eugene Bellemare, Shawinigan Falls, Roy Twinn, Ottawa, and William Westover, Brantford. J. L. McNulty is to serve as liaison officer for the coming year.

Texas Convention to McAllen

Annual convention of the Texas Pest Control Association this year will be held at the Fairway Motel in McAllen, November 16-18.

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Only Silikil...

- IS EASY TO APPLY!
- HAS EXTREMELY FINE BUT HEAVY PARTICLES!
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3-WAY *"Sugar-Base"* **FLY KILLER**

Kills flies like nothing else does! Pure cane sugar impregnated with a powerful new organic phosphate! Stops flies dead in their tracks! Flies are attracted to it, feast on it, die within seconds. What's more, they keep on dying for weeks after application. Kills *resistant*, as well as non-resistant strains; and flies do *not* become immune to it.

- **3 WAYS TO APPLY DIE-FLY!** . . . Scatter it as a dry bait. Dissolve in water and paint on surfaces where flies gather, or dilute it in water and spray it on.
- **KILLS MORE FLIES "Per Penny Cost"!** . . . A pound of Die-Fly actually kills 5 to 10 times as many flies as a pound of ordinary fly bait. Does it quicker! Lasts longer!
- **PROVEN SUCCESS!** . . . Over a million pounds of Die-Fly sold to date. Satisfied users in all 48 states. No caking in any climate! No shelf-life problem! No failures! Nothing but satisfied customers.

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Emulsifiable
BAIT SPRAY
CONCENTRATE
Write For Full Information!

PROOF of RESIDUAL KILL

AVAILABLE TO PEST CONTROL OPERATORS
NATIONALLY ADVERTISED UNDER THE WELL-KNOWN DIE-FLY LABEL
OR "IN BULK" FOR REPACKAGING UNDER YOUR OWN LABEL!

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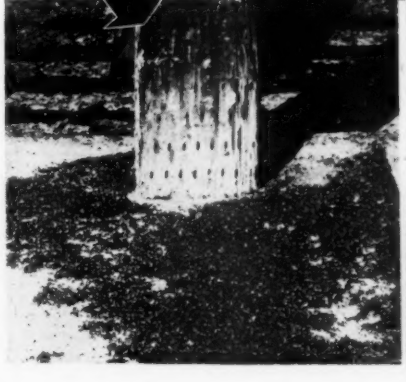

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Notebook

TIPS AND IDEAS FROM THE FIELD

Honey Removal Is PCO Bees-ness

It was a honey of a job for servicemen of Vogel-Ritt, Inc., Philadelphia, Pa., but the sweet smell of success lingered even longer than usual.

After they had successfully eliminated an infestation of bees from a wall void in an upstairs room of a home, they found the source of a prolonged nectareous amora.

Lodged in the void were living quarters for the honey-gathering insects which had attached 250 pounds of honey and wax to wooden lathes and plaster.

To get at the bees' nest, servicemen, under the supervision of Charles D. Cushing, Vogel-Ritt's manager, had to cut away a portion of the plaster wall. They found many cone shaped honeycombs dangling from a 2 x 4 cross stud and scads of honey oozing from the more irregular shaped combs fastened to the lathes.

How the bees were able to establish a colony in a wall without being noticed is somewhat of a mystery, but Cushing guesses they had been there quite a while in order to build up such a large storage of honey. The bees apparently made their entrance to the void through a crack near a window dormer that juts from the house just below the nest.

To get rid of the busy wax makers, Cushing ordered his men to use A-dust prior to removing the plaster walls, and applications of chlordane as needed during removal of the honey-combs. Stickiest part of the eradication job was to shovel out and carry away the wax and honey. Final treatment was with 20% DDT dust after the honey was cleaned out and before walls were refinished.

Dutch Elm, Mosquito Kits

Two fact-filled kits, "Facts About Dutch Elm Disease" and "Mosquito Control Data," are offered free by John Bean Division, FMC, Lansing 4, Mich.

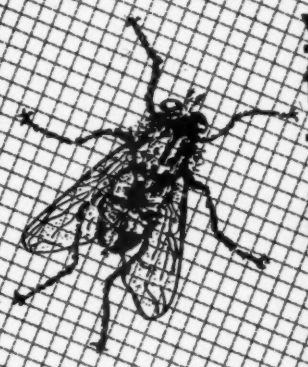
The Dutch Elm kit contains articles on controlling the spread of this tree disease, chemical spray material mixing data, facts of general interest, and a spray equipment catalog.

The Mosquito Control kit includes community case histories, spray methods and results from a 6-state area, general biological information, and a mosquito control-sanitation spraying catalog.

New Sprayer Handbook

B & G Co., Plumsteadville, Pa., reports it has a new Revised Sprayer Handbook that's just off the press and available free to readers of *Pest Control*.

250 lbs. of beeswax and honey were found behind plastered wall when bees were removed.



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Automatic Metered Dispenser

Pyrethrins-Piperonyl Butoxide Fly Killer

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*Dispenses 6.6 milligrams of Pyrethrins and Piperonyl Butoxide per hour per 1000 cubic feet . . . equal to 1/4300 of 1 ounce, yet guaranteed to destroy all flies in area!

*User's cost is only 8/100 of 1c per hour per 1000 cubic feet . . . a terrific selling point, and it still makes big, big profits for you!

This is why **SYNCRO-MIST & KONK** are the #1 Fly Control team:

- Scientifically developed and proven . . . thousands of units already in use
- Automatic metered action dispenses measured doses of insecticide 24 hours a day . . . unattended!
- Kills flies, mosquitoes, gnats . . . including "resistant" insects!
- Plugs into standard 110V AC electric outlet . . . one 12-oz. bomb of KONK lasts approximately 34 days!
- No evaporation or leakage . . . waste is eliminated!
- SYNCRO-MIST unit installed in seconds . . . handsome, unobtrusive!

GUARANTEED TO KILL FLIES AND PREVENT FLY POPULATION BUILD-UP

for complete descriptive literature, write to:

SYNCRO-MIST CONTROLS, INC. 270 MADISON AVENUE NEW YORK 16, N. Y.

Meet to Evaluate Ultrasonics for Structural Rat Control

Can ultrasonics be effectively used to control rats in buildings? That was the question put to some 14 men at a meeting held in Cleveland, Ohio, recently.

Sponsored by Cleveland Electronics, Inc. which has built several experimental ultrasonic rodent control units, the two-day seminar witnessed a movie that revealed rodent reaction to such a device at close range. Delegates also visited a flour milling plant in Cleveland where four similar units appear to be working in conjunction with conventional perimeter bait-box rodent control.

So far, laboratory findings indicate rats can be frightened away when the unit emits an ultrasonic signal within a frequency range of between 15,000 to 25,000 cycles at interrupted intervals. This has to be proved in the field where there are many obstacles that would block or absorb the sound.

Early estimates are that, if the machine proves successful, such a device could be sold for from $200 to $300. Whether this is economically practical also has to be determined. No claims have been made for the system, but several PCOs are testing units.

Is ultrasonic rat control practical? That's what these men were attempting to decide. They are (left to right) A. J. Hobday, Charles Specht (partially hidden by lamp), Dr. Lee C. Truman, Willard Drown, Bill Pickard, James A. Nelson, Robert Early, Jr., David G. Harris. (On coach in rear, l to r) John Gideon, Richard M. Yale, Harry Studier, Phil George (mostly hidden), and Arthur Sudbury.

Present at the meeting were Cleveland PCOs Harry Studier and Willard Drown of Guarantee Exterminating Co., and John Gideon of Knox Pest Control, as well as William Pickard from International Pest Control Co., Buffalo, N.Y.; Dr. Lee C. Truman, Pest Control Services, Inc., Indianapolis, Ind.; A. J. Hobday and Charles Specht of the Kroger Co., Cincinnati, O.; Robert Early Jr., Early & Daniel Co., Louisville, Ky.; Richard M. Yale from S. B. Penick & Co. Detroit, Mich. office; James A. Nelson, editor of *Pest Control*; and representatives of Cleveland Electronics, Inc., Phil George, president, David G. Harris, vice president, and Arthur Sudbury, engineer, along with Al Lang, inventor of the device.

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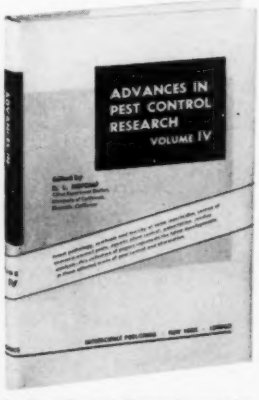

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R. L. METCALF
University of California, Riverside

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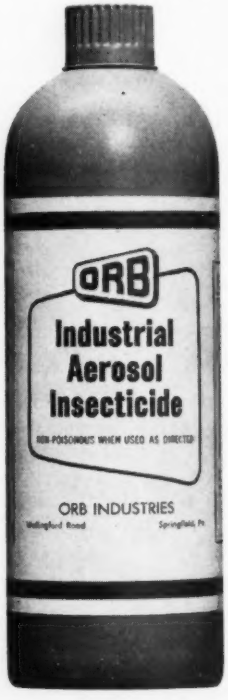

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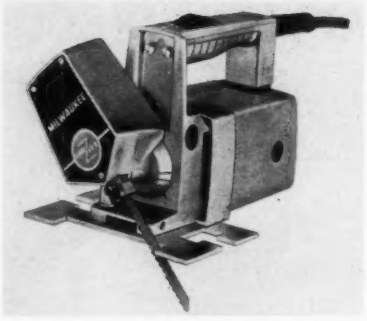
Butonate Gets UDSA Okay

Butonate, a new insecticide with reportedly low mammalian toxicity, may now be used in aerosols and in contact and residual insecticides as a result of a registration with the U. S. Department of Agriculture. This announcement came from Ward Ross, managing director of the Wisconsin Alumni Research Foundation, developer of the compound, which has given a license to manufacture and distribute butonate to Prentiss Drug & Chemical Co.

Said to be effective against flies, gnats, mosquities, roaches, and silverfish, butonate is chemically O, O-dimethyl 2,2,2-trichloro-1-n-butyryloxyethyl phosphonate. In laboratory studies with white rats, it has shown "extremely low mammalian toxicity, approximately 1,100 mg/kg of body weight, when administered orally," WARF claims.

Complete labeling and formulating information is available from Prentiss Drug & Chemical Co., 101 West 31st St., New York 1, N.Y.



Flush-cut miter sawing is said to be possible with this new heavy-duty Jig Saw Sawzitt being introduced by Milwaukee Electric Tool Corp., 5300 W. State St., Milwaukee 8, Wisc. Weighing but 5 lbs., Sawzitt features an adjustable pivoting head which allows the tool to remain upright even on 45 degree cuts. Powered by a ¼ hp motor, the tool is reportedly designed to cut straight lines, curves and intricate scrolls in practically any sawable material at a rate of 3500 ¾" strokes per minute. For more information, write Milwaukee Electric Tool and ask for Sawzitt Bulletin SW-37.

5-Year DDVP Know-How Claimed

Alco Chemical Co., Artesia, Calif., claims it has had nearly five years know-how in formulating pesticides containing DDVP.

Latest in its line of insecticides is a pressurized Fly Fighter Insect Spray which is said to kill flies, roaches, ants, mosquitoes, and many other insects. It also has a new Super XX Bait that is a double-strength DDVP granual fly bait with fluorescein and special attractants which, according to the company, kills flies faster than standard DDVP baits.

A double-strength liquid concentrate, with 2 lbs. DDVP per gallon in a stabilized formulation, is still another new addition to Alco's line. Write the company for further details on these products.

Shell Has "Short Course" Folder

"1960 Pest Control Operators Short Course" is the title of a collection of pertinent Shell Chemical Co. labels and helpful sales material bound under one cover now available free from the company at 212 South Central Ave., Clayton 5, Mo.

Included is information on Vapona DDVP, control of household insects with dieldrin, lawn and turf insect control, boxelder bug, earwig, mosquito, peachtree borer, and termite control.

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Book Review

Advances in Pest Control Research, Volume IV

Edited by R. L. Metcalf. Interscience Publishers, Inc., 250 Fifth Ave., New York 1, New York. 348 pp. $12.50.

This fourth volume in Dr. Metcalf's series includes the writings of eight guest authors with information of particular interest to the serious pest controller who wants to know more about how insecticides act.

Chapters cover some fundamental aspects of applied insect pathology, synthetic pyrethroids, selective toxicity of insecticides, potentiation of the toxicity of organophosphorus compounds, chemical control of insect pests of domestic animals, residue determination by cholinesterase inhibition analysis, principles of aquatic plant control, and a digest of available information on malathion.

In these days when many pest control workers, faced with resistance problems, try to "cook up" their own formulations by adding a little of this and dumping in a little of that, the cautions in the chapter on potentiation should be worth the price of this book, and maybe even a life. Results of tests on about 50 pairs of pesticide compounds are described. "The greatest danger from potentiation of the toxicity of organophosphorus insecticides lies in the possibility of acute exposure to potentiating pairs during their manufacture and application," the author points out.

Use of large type and many reference tables make this a reference text, easy to use.

Legislation Affecting PCOs

Colorado has *enacted* House Bill No. 160 which amends the state's Insecticide, Fungicide, and Rodenticide Act by adding plant regulators, defoliants, desiccants, and nematocides to conform with the amendment to the Federal Act.

Massachusetts has *enacted* its new pesticide law which becomes effective July 1, 1961 and requires the registration of all pesticides packaged for resale. For registration blanks write to George A. Michael, Director, Division of Food and Drugs, Department of Public Health, State House, Boston 33, Mass.

Minnesota has *enacted* Senate Bill No. 411 which amends the ingredient statement provisions of the Minnesota Economic Poisons Law by permitting the ingredient statement to be displayed in accordance with Option 2 under the Federal Act.

Rhode Island has *pending* Senate Bill No. 462 which requires the labeling of any product of household chemicals that is contained under pressure and is dispensed in the form of a spray.

Washington has *enacted* House Bill No. 140 which requires any dealer offering for sale any pesticide in commercial quantities or highly toxic pesticides to obtain an annual license with a registration fee of $10.00.

West Virginia has *enacted* House Bill No. 232 which provides for registration, examination, and control of economic poisons. Registration fees of $10 for the first 20 economic poisons registered, and $5 for each additional label registered, are part of this new bill.

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Resistance of Canadian Roaches to Chlordane Is Finally Proved

A. W. A. Brown and E. K. Wambera, of the Department of Zoology, University of Western Ontario, London, Canada, report the first proof of strong resistance in German roaches in Canada. Chlordane-resistant roaches had previously been reported to the NPCA in 1959 by operators in Montreal, Toronto and Windsor, but no quantitative tests for resistance were made.

During 1960 collections were made of German roaches suspected of being chlordane-resistant at the Royal Canadian Air Force stations at St. Hubert, Que. and Goose Bay (Labrador), Nfld. They were tested by the method devised by the USDA laboratory at Orlando and described as standard in Technical Information Manual No. 3 of the U. S. Armed Forces Pest Control Board. Dieldrin was used as the test insecticide because it is a relatively pure chemical, and because chlordane-resistance is of a type characterized as dieldrin-resistance. In this test, resistance is detected by an increase in the median time to knockdown (LT_{50}) on continuous exposure to the chemical. The original St. Hubert collection and the first filial generation of the Goose Bay collection were tested.

Smith's new Garden King No. 510 power sprayer is now available in a 10 gal. size. Comes equipped with 15 ft. heavy duty chemical resistant hose, the portable rubber-tired unit has an all steel tank said to be coated with a special bond, anti-corrosive coating inside. For more information, write D. B. Smith & Co., 440 Main St., Utica, N. Y.

As an index for normal roaches, the Orlando regular colony showed LT_{50} of 2.4 hr. for males and 6.6 hr. for females; an Illinois reverted strain showed an LT_{50} of 84 hr. for males; the females were not tested. The Goose Bay collection showed an LT_{50} of 168 hr. for males, the mortality subsequently not increasing beyond 50%; the females showed 0% mortality for an exposure of 168 hr., and 10% at 192 hr. when the exposure was terminated.

It may be concluded from the data with males that the St. Hubert strain is 35 times as resistant as normal, and the Goose Bay roaches 70 times. The females from Goose Bay showed virtually absolute resistance, and a vigorous colony has been obtained from the survivors of the 8-day exposure. Both strains are considerably more resistant than the well-known resistant strain from Fort Rucker, Alabama, whose LT_{50} is 13 hr. for males and 24 hr. for females. It is interesting that the resistant Goose Bay population was restricted to a single building, German roaches in the other buildings on the station being still susceptible to chlordane applications.

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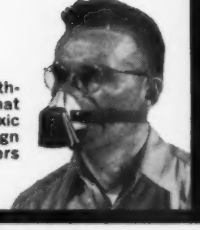

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Calendar

Pennsylvania Pest Control Assn. (Eastern Division) Monthly Meeting, Shoyer's Restaurant, 410 Arch St., Philadelphia, June 8, 6:00 p.m.

Maryland Pest Control Assn. Monthly Meeting, Lord Baltimore Hotel, Baltimore, June 21, 6:30 p.m.

Texas Pest Control Assn. A & M Short Course, A & M College, College Station, Tex., June 22, 23.

Florida Pest Control Assn. Annual Convention, Holiday Inn, Palm Beach, June 23, 24.

PCOs of California, Inc. Mid Summer Conference, Brookdale Lodge, Santa Cruz, June 23-25.

Pest Control Assn. of South Florida Annual Meeting. Lindsey Hopkins Vocational School, Miami, June 26, 6:45 p.m. dinner; 8:00 p. m. meeting.

Professional Pest Control Assn. of Dallas County Monthly Meeting. El Chico Restaurant, 110 W. Davis, Dallas, Tex., 7 p.m., July 13.

Ohio Pest Control Assn. Mid Summer Meeting, Midway Hotel, Pearl Rd., Cleveland, Aug. 3-5.

Tri-State (N.C., S.C., Ga.) Mid Summer Convention, Grove Park Inn, Asheville, N. Caro., Aug. 3-5.

Virginia State Pest Control Assn. Next tentative meeting date set for Aug. 18, 19, place to be announced.

Ohio Pesticide Institute, Ohio Agricultural Experiment Station, Wooster, Aug. 22, 23.

Alabama Pest Control Assn. Annual Meeting, Montgomery, place to be announced, Sept. 15, 16.

Doom for Japanese beetle control is a new white odorless powder of Milky Disease microbial spores produced by Fairfax Biological Laboratory, Clinton Corners, N.Y. It comes in a 2½ lb. tub, packaged in a reusable ½ gal. plastic container, said to be enough to treat an average ¼ acre of lawn.

Washington, D. C., Pest Control Assn. Meeting, 4904 Wisconsin Ave., N.W., 8 p.m., Sept. 18.

National Pest Control Assn. 28th Annual Convention & Trade Show, Deauville Hotel, Miami Beach, Fla., Oct. 15-19.

National Agricultural Chemicals Assn. 28th Annual Meeting, The Homestead, Hot Springs, Va., Oct. 29-Nov. 1.

Nebraska Assn. of Pest & Termite Control Operators, Inc. Annual Meeting and Short Course. Town House Motel, Omaha, Nov. 16, 17.

Texas Pest Control Assn. Annual Convention, Fairway Motel, McAllen, Nov. 16-18.

Ohio Pest Control Assn. Annual Meeting, Commodore Perry Hotel, Toledo, Nov. 29-Dec. 1.

PCOs of California, Inc. Cal-Poly Conference, Cal-Poly Institute, Pomona, Dec. 16.

64% Ohio Farmers Use PCOs

A U. S. Fish & Wildlife Service survey of farmers in Licking County of the State of Ohio reveals 64% of them use commercial pest control firms to do their pest control work. Being primarily concerned with rodents and birds, USF&WLS animal control agent, Paul M. Ochs, stationed at the Courthouse in Lancaster, Ohio, found farmers who did not have pest control programs were "giving" 6 to 7% of their profits to rats. A total of 14 grain elevators were surveyed in the county.

Electric Tool Buying Guide

More than 400 accessories and 72 portable electric tools are described in a new 34-page buying guide offered free by The Porter-Cable Machine Co., Syracuse 1, New York.

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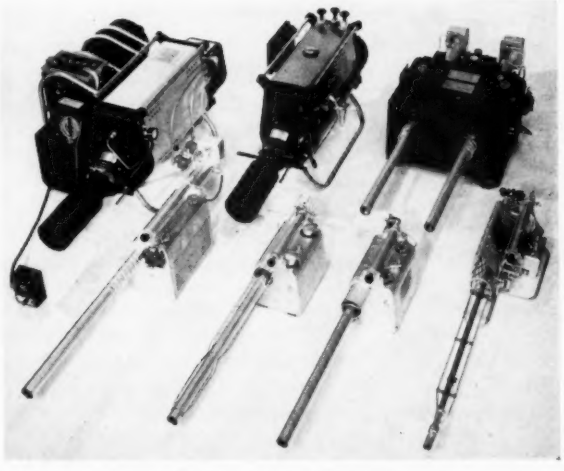

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Hubsco-147 comes in various size containers.

Hub States Has New Rat Bait

A rodent bait formula with an anticoagulant base, blended with a reportedly new combination of attractants, has just been introduced by Hub States Chemical & Equipment Co., 1255 N. Windsor St., Indianapolis, Ind.

Called Hubsco-147, the firm is packing the bait in polyethylene to guarantee freshness. Each container is easy to reseal to maintain that freshness, according to Bryan Auer, Hub States president.

Because of its anticoagulant base, safety and lack of bait shyness are assured the company claims. It comes in 5 lb. cans, 25 lb. pails, and 50, 100, and 200 lb. drums. For prices and further details, write Mr. Auer at Hub States.

Suppliers' Staff Changes

Virginia Chemicals & Smelting Co. has promoted J. A. Weatherford to the newly created position of Director of Sales covering industrial chemicals, refrigeration and air conditioning products, and aerosols. He has been with the company since 1954 and will work from its headquarters in West Norfolk, Va. In other new appointments, Virginia Chemicals has made Neal Kincannon its Southwestern District representative for aerosol sales, and Dr. E. B. Hotelling newly established associate director of research.

Great Lakes Chemical Corp. announces that Marshall M. Manns has joined its organization as manager of agricultural chemical sales. Charles S. Hale, Great Lakes president, explains that Mr. Manns will be stationed at a newly-opened office in Kansas City, Mo. Formerly Mr. Manns had been with Michigan Chemical Co. selling its fumigants. In his new position he will be responsible for sales of G-L agricultural chemicals and fumigants.

Dow Chemical Co. has appointed John P. Strouss as chemical district sales manager in its New York office.

Geigy Agricultural Chemicals has made Bill Hightower a member of its South Central District field sales staff. He had previously been with Velsicol Chemical Corp., Diamond Alkali Co., and the Agricultural Division of Delta Air Lines. D. L. Odle is Geigy's new Iowa representative.

McLaughlin Gormley King Co., announces the appointment of William D. Gullickson as manager of international sales.

W. C. Vereen, president of Riverside Manufacturing Co., announces the appointment of Vernon H. Dunnegan as sales representative in Louisiana and East Texas for the uniform manufacturers which has its headquarters in Moultrie, Ga. He replaces Roy Fletcher who has retired.

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Here's a spray gun that's drip-free after shut-off no matter how it's held or how long the extension. Ends chemical waste and the nuisance of dripping. Supplied in complete choice of interchangeable orifice tips for flat, hollow cone, full cone and solid stream sprays. For information write for Data Sheet 7676.
For lighter duty spraying, see the Trigger TeeJet shut-off valve with straight or curved extensions. Also bottle sprayers for sanitation spraying and related applications.

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New Model
UNI-VAP INSECTICIDE VAPORIZERS

Sell Better
Perform Better
Look Better

Backed by 10 years of successful sales, Uni-Vap assures effective, economical insect control. Guaranteed performance and construction for complete customer satisfaction. Competitive price and long margin produce maximum profit for you.

UNIVERSAL ORTHO-LINDANE
Fresher for higher potency
Better kill in any vaporizer
1 oz. heat sealed, leakproof packets
1 lb. cans.
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EARWIGS • SOD WEBWORMS
ROUGH HEADED CORN STALK BEETLES

FIRE CRACKER soil insect killer is in granular form. . .more convenient and efficient. FIRE CRACKER granules deliver the poison in sufficient strength to give QUICK KILLS and in the correct place for maximum results.

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FIRE CRACKER IS AVAILABLE IN 4-POUND REFILL BAGS AND 50-POUND FARM AND RANCH BAGS

AVAILABLE AT YOUR MISSION BRAND CHEMICALS DEALER

Manufactured by
HAYES-SAMMONS CHEMICAL COMPANY, Mission, Texas • Indianola, Mississippi

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Wonderful Sideline Profit Maker for Over-the-Counter Sales

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The New Effective Fumigant That Will Kill

Mosquitoes, Flying Moths, Spiders, Silverfish, Flies, Wasps, and Exposed Waterbugs, Roaches, Bedbugs, and Ants.

FUMO-KILL is truly the modern method of insect extermination. Light match to contents in can, will produce fumes — NO FLAME. Non-hazardous. This amazing FUMO-KILL insecticide has been tested, and found effective against most types of household pests.

FUMO-KILL has the following advantages:

EASY TO USE: Requires no Special Equipment.

ECONOMICAL TO USE: Two ounces fumigates up to 6,000 cubic feet.

EFFECTIVE TO USE — Follow instructions on can for best results. This Amazing FUMO-KILL insecticide is by all qualifications, a leader in its field.

FUMO-KILL can be obtained in 2 oz. (enough for up to 6,000 cubic feet)—4 oz. and 1 lb. cans.

Cost of 12—2-oz. Cans.....$ 7.50 per doz.
Cost of 12—4-oz. Cans.....$13.50 per doz.
Bulk.....$ 4.50 per lb.

Delivery Charges Prepaid
For complete information write or phone today.

MAR-MEL PRODUCTS, INC.

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753 South Kedzie Ave. Chicago 12, Illinois

Easy to Install RID-A-BIRD PERCH ELIMINATES BIRD PROBLEMS

Unsightly, unsanitary and costly conditions caused by pest birds can now be safely solved by the unique Rid-A-Bird perch. Easily installed (see photo) and refilled only twice a year, the perch insures permanent removal of sparrows, starlings and pigeons. Successful installations include factories, aircraft hangars, grain elevators, loading docks, warehouses, farm buildings, garages, stores and buildings.

Send for new brochure showing installation details:

RID-A-BIRD, INC.
P.O. Box 22, Dept. PC -11
Muscatine, Iowa

NAME

ADDRESS

CITY STATE

Classifieds

When answering ads where box number only is given, please address as follows: Box number, c/o Pest Control, 1900 Euclid Avenue, Cleveland 15, Ohio.

Rates: "Position Wanted" 5c per word, minimum $2.00. All other classifications, 10c per word, minimum $2.00. All classified ads must be received by Publisher the 10th of the month preceding publication date and be accompanied by cash or money order covering full payment.

POSITION WANTED

ENTOMOLOGIST, 37 years old, with degree in structual pest control. 14 years experience management in sale of pest control, termite, fumigation, sanitation inspections, equipment and chemicals. Married, willing to move anywhere for good position. Box 593, Pest Control magazine.

EXPERIENCED 12 years in all phases of pest control. Fully experienced as sales manager (85 to 90% average closing), general manager, 2 years at Business Administration at LaSalle College. Interested in relocating in Florida, New Orleans, or Southern California. Write Box 594, Pest Control magazine.

HELP WANTED

SERVICE MANAGER for general pest control. Prefer graduate entomologist or with equivalent experience. Also qualified servicemen. Preference given to those taking Purdue University Pest Control Correspondence Course. Salary, expenses, paid vacations, income when ill, free life insurance, medical and surgical hospitalization insurance plans. All replies held strictly confidential. Anderson Exterminating Co., 1735 W. Jackson Blvd., Chicago 12, Ill., SEeley 3-0101.

MANAGER-SALESMAN. Large exter- minating termite company in New York desires thoroughly experienced man with car. Excellent opportunity for advancement. Confidential. Box 589, Pest Control magazine.

RAPID EXPANSION PROGRAM in Midwest enables us to offer qualified servicemen, salesmen and managers guaranteed salary and commission; Opportunity for advancement; permanent, year 'round employment; paid vacations, income when ill; outstanding fringe benefits including profit sharing, retirement (pension) plan; medical and surgical, hospitalization insurance, etc. Company pays all premiums. All replies held strictly confidential. Arwell, Inc., Waukegan, Illinois.

EXECUTIVE MANAGER for pest con- trol, fumigation and chemical company in southern California. Salary may run into five figures. Also opportunity to buy shares in corporation if desired. Write Box 587, Pest Control magazine.

PEST CONTROL's
CLASSIFIED ADS GET RESULTS
USE THEM

FOR SALE

PEST CONTROL business in the tropics, established 1935, 14 trained employees, license available, located in largest and capitol city, grossing over $110,000 annually. Retirement reason for selling. Write Box 590, Pest Control magazine.

SYNTRON SELF-Rotating hammer, Model 26RO, 18 months old. Perfect condition with chucks. $150. Termite Proofing Service, Inc., Lakewood, New Jersey.

WELL ESTABLISHED pest and ter- mite control business in Central North Carolina. Nine years old, excellent reputation. Corporation with general trade name. Would make excellent "nucleus" for large company seeking expansion throughout state. Present owner-manager has other business. Box 592, Pest Control magazine.

WANTED TO BUY

PEST CONTROL company or interest in firm in Florida. Experienced and qualified in all phases of business. Give details and price. Replies strictly confidential. Box 591, Pest Control magazine.

USED BUFFALO-Turbine spray- duster. Either Jeep-mounted, duster only, or any type, etc. Danville Spray Service, Inc., Box 85, Danville, Va.

FOR A NEW YORK City operator who may be overworked or looking toward retirement. Satisfactory terms for an outright sale or an agreement for a secured income can be arranged, based on partial or complete retirement. Excellent references. Replies in strictest confidence. Box 584, Pest Control magazine.

WANTED— RED SQUILL, powder or extract. Advise potency and condition. Write Eaton & Co., 1106 Lakeview Rd., Cleveland 8, Ohio.

MISCELLANEOUS

TO EMPLOYERS who advertise for men. The letters you receive in answer to your advertisements in *Pest Control* are submitted by each of the applicants with the hope of securing the position offered. When there are many applicants it frequently happens that the only letters acknowledged are those of promising candidates. (Others do not receive the slightest indication that their letters have even been received, much less given any consideration.) These men often become discouraged, will not respond to future advertisements and sometimes even question if they are bonafide. We can guarantee that Every Advertisement Printed in *Pest Control* is Duly Authorized. Now won't you help keep our readers interested in this advertising by acknowledging every application received, even if you only return the letters of unsuccessful applicants to them marked, say, "Position filled, thank you"? If you don't care to reveal your identity mail them in plain envelopes. We suggest this in a spirit of helpful cooperation between employers and the men replying to Help Wanted advertisements. Put yourself in the place of the other fellow.

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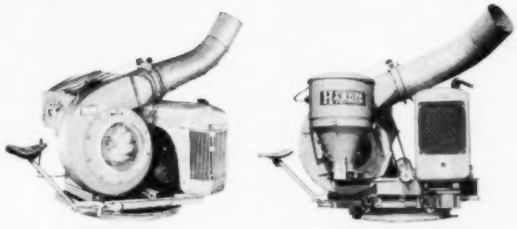
"Electric" Grain Insect Control

A free copy of "Effects of High Frequency Electric Fields on Certain Species of Stored-Grain Insects," Marketing Research Report No, 445, may be obtained from Office of Information, U. S. Dept. of Agriculture, Washington 25, D. C.

NOW 2 Machines in 1



SPRAYER SPRAYER-DUSTER

HARDIE *Aero-Mist* SPRAYER-DUSTER

Here's the one unit that gives you just what you want, when you want it. The famous Hardie Sprayer. It embodies the recommendations of State & Federal authorities; tree service organizations and foresters who sought in one unit a high velocity, ample air volume sprayer for any type job, along with low price.

With its high velocity — 150 MPH — it is of special value in the treatment of trees infested with the bark beetle. Public Health officials also use the Hardie for mosquito control. With the attachment of the Hardie Duster, you then can use either spray materials, or dust or granular materials.

Write today for full particulars

THE HARDIE MANUFACTURING COMPANY, INC.

730 S. Main Street

WILKES-BARRE, PENNSYLVANIA

RAT CAFETERIA KILLS RATS!

Feeds 1 Full Quart Of Liquid Bait And More Than 6 Pounds Of Dry Bait

- LOW COST
- CERTAIN
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FREE AUTOMATIC, LIQUID DISPENSER WITH EACH RAT CAFETERIA

"SEE IN" VISIBLE BAIT CHECK

SIZE 7 3/4 x 13 x 13

Today's largest-selling bait station. Approved by health authorities everywhere. Fabricated of heavy galvanized steel. Many report over 5 years of continuous use. No identification. Imprint your name.

Sample Cafeteria $3.00; Lots of 12, $2.25 ea. Lots of 48, $2.10 ea. Lots of 102, $1.95 ea. All prices F.O.B. Madison, Wis.

NESTED DESIGN SAVES YOU MONEY

New, slanted-side design nests 6 units to a carton. Saves 50% on freight, 50% on storage!

U.S. Patent No. 2,944,364

Write for our low prices on Warfarin Baits

SOLVIT CHEMICAL COMPANY

3734 SPEEDWAY ROAD MADISON 1, WISCONSIN

The Original . . .

And Still The Best!

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POWDER BLOWER

$1.50 EACH F.O.B. St. Louis, Mo.

Order Your Supply Today!

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2234 OLIVE STREET ST. LOUIS 3, MO.

SMO-CLOUD BUG KILLER

Registered with the U. S. Dept. of Agriculture

1 doz. 2 oz. cans **$7.80**

1 doz. 4 oz. cans **$13.50**

ALSO MOTH-CLOUD and BUG-TAB TABLETS

1. For your regular service work.
2. For your one-shot special jobs.
3. For a highly profitable resale product.

Send for **FREE SAMPLES** Today!

Continental Chemiste Corp.
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Please RUSH samples of SMO-CLOUD, MOTH-CLOUD and BUG-TAB to:

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Address_____

City_____

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Pestales

Ultrasonic bee control? **A swarm of bees in Winston-Salem, N.C. was disrupting traffic for half a block in every direction, until U. G. Atkins, serviceman for Wilson Exterminating Co., Inc. came to the rescue. As he came out of an account he'd been servicing and returned to his car, he noticed the swarm. He began blowing his horn steadily causing the bees to cluster instead of chasing the queen. The bees were attracted to the pale green of a 1961-model auto nearby and completely covered one side of the left rear fender. Atkins then donned a bee bonnet and a net and scooped up the hornswoggled bees.**

Clocked roaches. A British woman scientist believes she has discovered that cockroaches possess biological clocks which enable them to follow a 12-hours-on, 12-hours-off routine of running around all night and sleeping all day. She's even found that the clock from one roach can be transplanted into the bloodstream of another without missing a tick. That's her story and roaches must be stuck with it, especially those resistant species which seem as active in the daytime as they are at night.

* * *

Soldiers of Fortune. **These days when our political freedoms are at stake and soldiers of fortune are as welcome as a tax refund check, it's good to find PCOs taking part in the protection of our American heritage. Recently Texas termites completed a philosophy course and were sampling American history when they were caught in an educational record maker's storeroom. They had eaten the cartons, cardboard jackets, and paper labels of more than 100 spoken word records stored by Academic Recording Institute in Houston. Long Exterminating Co., a Houston-licensed PCO, came to the rescue and kept the scholarly nibblers from attacking political science, fine arts, and anthropology, subjects also available to them in the storeroom.**

* * *

Cat-tale. The story goes that the rough and tough dockmen we've heard so much about along New York's waterfront are really pushovers for pussycats. There are longshoremen "Cat Men" who make it their personal responsibility to feed cats that keep rats off the piers; why they've even been seen bottlefeeding kittens! In some sections, pier cats have a menu. On Mondays it's meat loaf. Tuesdays bring top sirloin. Wednesday they get fresh ham and Friday is time for fillet of sole. This is the daytime fare. Every night the menu is the same: rattus rattus rattus. Wonder if these felines have a license to do pest control from the City of New York Health Department.

* * *

Swan Lake rat-lay. **The Swan Lake area near Tulsa, Oklahoma, was recently dancing with rats but the public sounds that resulted were not intended to be harmonious accompaniment such as Tschaikowsky wrote. Fumigation was recommended by Clyde Eller, Tulsa City-County Health Department chief sanitarian, to the mayor and park department, but there was no money for the project. Charles Rosenthal, owner of Charles Pest Control, Inc. in Tulsa, volunteered to fumigate, without charge, the lakeshore, 75% of which was infested with rats that had burrowed into the banks. This was music to residents of the Swan Lake area and a fine piece of public service on Charlie's part.**

* * *

Birds of no feather. The noisy bird problem can be solved according to the American Municipal Association. And one of the ways they suggest was developed in Newton, Massachusetts. There harassed city fathers were bothered by pigeons that infested the city hall and asked the town's forester for help. With his high-pressure tree sprayer, he literally blew the flock sky high with blasts of air, partially denuding some of the one-time birds of a feather flocking away fairly fleeced.

* * *

Hess makes the big Times. **You can't keep a good newspaper man down. Jacques Hess, who runs Exterminating Services Corp. in New York City, has in his job background a stint when he was a newspaper reporter. And Jacques is a man who recognizes a good story when he sees one . . . especially when he says so himself about his own company. Earlier this year the front page of the real estate section of The New York Times carried a full column story about the pest control industry in New York quoting Jacques liberally. And PR man that he is, Jacques writes, "This is almost as good as getting space in Pest Control!" Flattery will get you everywhere.**

PROVEN FORMULA for PEST CONTROL

All methyl bromide is "A binary compound of bromine with the hydrocarbon radical CH_3 (methyl)" . . . but

GREAT LAKES METHYL BROMIDE FUMIGANT

offers you all these advantages:

- **EFFECTIVENESS** — Great Lakes Methyl Bromide has top penetrating power . . . kills insects fast and effectively . . . guarantees your doing a good job every time.
- **SAFETY** — Great Lakes Methyl Bromide, when used properly, is safe and easy to handle . . . kills all pest life . . . non-corrosive to metal.
- **QUALITY** — Great Lakes Methyl Bromide is produced in our own modern plant, using brine from our own wells . . . our high quality is uniform at all times, backed by 25 years' experience in bromine and bromine derivatives.
- **SERVICE** — Great Lakes Methyl Bromide offers you a simplified purchasing system for delivery from our Filer City, Michigan plant or from strategically located warehouse stocks . . . practical assistance, too, in filling your particular requirements.

GREAT LAKES METHYL BROMIDE IS AVAILABLE WITH OR WITHOUT CHLOROPICRIN WARNING AGENT

AVAILABLE IN cylinders containing 375, 200, 175, 100, 50 or 10 lbs . . . and in 1-lb. aerosol cans, packaged 24 to a case.

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Fairfield Facts

CHEMICAL EDITION ★ ★ ★

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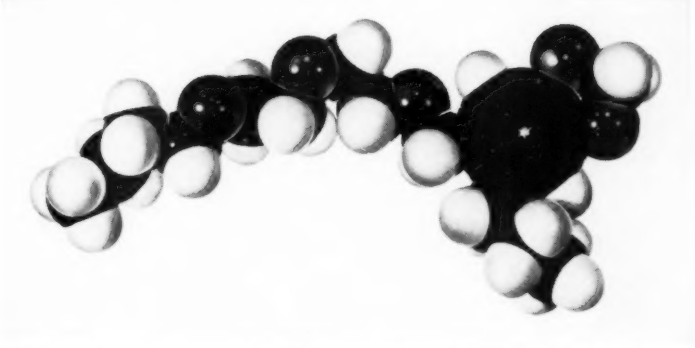
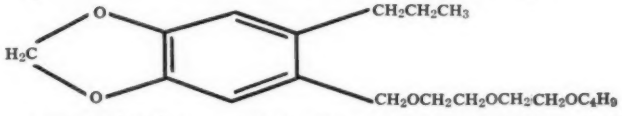
PIPERONYL BUTOXIDE

Technical Data



Physical and Chemical Properties



Spec. Grav at 20°/20° C.	1.040-1.070	Approx. wgt./gal.	8.79 lbs.
Propellent insolubles	None	Solubility in base oil	100%
Color G-H 1933	9.5	Flash Point °F.	310
Refractive Index at 25° C.	1.494-1.510	Water Content	0.05%

Soluble in most organic liquids including petroleum oils.

The active ingredient of piperonyl butoxide is 1-(2,5,8- trioxadodecyl)-3, 4-methylenedioxy-6-(n-propyl) benzene. For registration purposes, the Commercial product may be designed as consisting of at least 80% (Butyl carbityl) (6 propyl-piperonyl) ether and 20% of related compounds.

Piperonyl Butoxide protects pyrethrins as it synergizes. Piperonyl Butoxide reduces the effect of light, air and heat on pyrethrins and screens out ultraviolet light. As an acid acceptor it retards decomposition and polymerization.

SYNERGISM and effectivness of ratios of pyrethrins and piperonyl butoxide on houseflies (Compilations from probit-regression studies).

Equal cost, base oil dilutions	**Avg. Knockdown (%)**			**24 Hr.**
	3 min	**5 min**	**10 min**	**KD Kill**
Pyrenone KD Conc.	53	70	92	61
Pyrenone Roach Spray Con.	55	69	93	72
Pyrenone 20 New	61	80	94	76
Pyrenone O.T. 50-5	63	72	94	82

*Reg. U.S. Pat. Off., FMC

Putting Ideas to Work

fmc FOOD MACHINERY AND CHEMICAL CORPORATION

Fairfield Chemicals
Sales Headquarters
441 LEXINGTON AVENUE, NEW YORK 17, N.Y.
Branches in principal cities. In Canada: Natural Products Corporation, Montreal and Toronto.

Toxicological Properties

Undiluted Piperonyl Butoxide-Acute oral
LD50 for rats 11,500 mg/kg.
Chronic oral
LD50 for rats 8,750 mg/kg.

Extensions have been granted for piperonyl butoxide as per Paragraph 121.87 Federal Register of February 27, 1960 which states:

"#121.87 Extension of effective date of status for certain specified food additives as indirect additives to food.

"On the basis of data supplied in accordance with #121.85 and findings that no undue risk to the public health is involved and that conditions exist that make necessary the prescribing of an additional period of time for obtaining tolerances or denials of tolerances or for granting exemptions from tolerances, the following additives may be used in connection with the production, packaging and storage of food products, under certain specified conditions, for a period of 1 year from March 6, 1960, or until regulations shall have been issued in accordance with section 409 of the act, whichever occurs first. The extensions are granted under the condition that a minimum quantity of the additive will be incorporated in the food, consistent with good manufacturing practice."

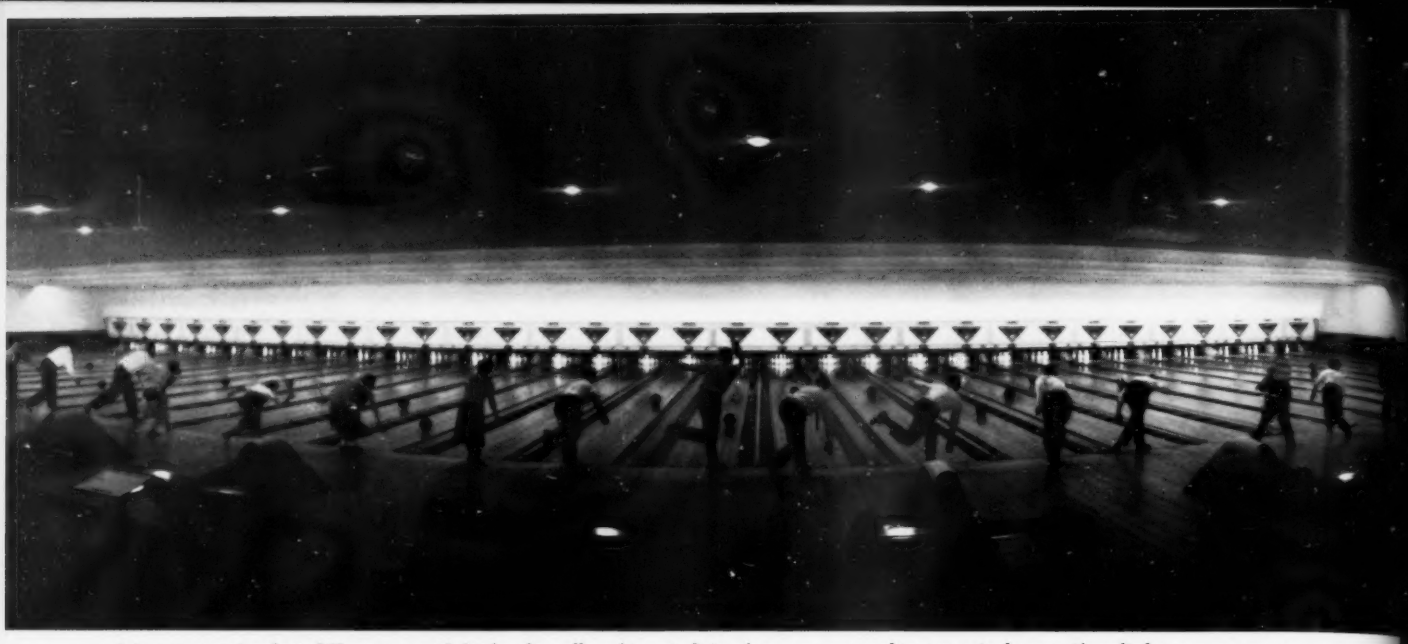
BIOLOGICAL PROPERTIES

Although not an insecticide in its own right, piperonyl butoxide synergizes pyrethrins, allethrin and rotenone to a marked degree enhancing both the knockdown and kill properties on most major flying and crawling insects.

Copies of the following booklets may be obtained from local Fairfield representatives or by writing to Fairfield Chemicals, Food Machinery and Chemical Corporation, 441 Lexington Avenue, New York 17, New York.

☐ Pyrenone* Condensed Facts Folder—Summary of Tolerances, Extensions. Free of charge.

☐ FAIRFIELD FACTS FINDER—a new, 20-page comprehensive guide and unique, revolving calculator covering Pyrenone base formulations for dairy, garden, home and industrial sprays, aerosols and powders as well as an index to insects and pests. Price—$1.00



A few ounces of technical Vapona can rid this bowling alley of insects. It is safe to use—no need to stop a single game if applied as a coarse spray.

ANNOUNCEMENT:

A few ounces of remarkable new Vapona® Insecticide (technical DDVP) can make this 265,320 cubic-foot bowling alley free of annoying insects

Vapona is a new phosphate insecticide. It is highly effective against a wide range of public health insects. Very low dosages kill even resistant strains.

Read how new Vapona can be applied safely using standard equipment and techniques. And how you can start using it for more effective and economical control of insects.

New Vapona works differently than other insecticides.

In addition to killing insects on contact, it has a vaporizing effect. Insects can no longer avoid being killed by hiding in cracks, crevices and other hard to get at places.

Vapona knocks down and kills insects within a few minutes of application. Then, it disappears rapidly with ordinary ventilation.

Low cost

Vapona is applied at extremely low dosage rates. As little as ½ to 2 milligrams per cubic foot controls the toughest insects.

Because Vapona kills at such low dosage rates it is economical. It can do a better job of controlling insects for half the cost of many other insecticides.

Safe to use

Vapona offers safety in use. When applied as a coarse wet spray at recommended dosages, there is no need to wear a respirator. It is not necessary to evacuate inhabitants of homes, restaurants, stores and other public places while application is being made.

When fogging or mist spraying indoors, the building should be evacuated and the applicator should wear a respirator. Buildings should be ventilated before people are allowed to re-enter.

Vapona can be applied with all standard application equipment.

Available in 4 forms

Vapona Insecticide is available in emulsible concentrates and concentrated solutions for further dilution and in liquid and dry baits. Ask your regular supplier for Vapona Insecticide.

For more information, write: Shell Chemical Company, Agricultural Chemicals Division, 110 West 51st Street, New York 20, N. Y.

Control all these insects with Vapona

1. Flies	8. Spiders
2. Mosquitoes	9. Silverfish
3. Wasps	10. Fleas
4. Flying moths	11. Fruit flies
5. Gnats	12. Phorid flies
6. Cockroaches	13. Other small flying insects
7. Ants	

Shell Chemical Company

SHELL

Agricultural Chemicals Division

Printed in U. S. A.